MOTOR AGE

Vol. XXXIII
No. 9

CHICAGO, FEBRUARY 28, 1918

Ten cents a copy
Three dollars a year

Stop that Leak

THE easiest and quickest way of repairing leaks in radiators, pumps, water jackets, motor head gaskets, hose connections, etc., is to use Johnson's Radiator Cement. This will stop the leaks in just a few minutes, without laying up the car. No mechanical experience is required—all you have to do is to remove the cap and pour the cement into the radiator. It will ordinarily seal a leak in from two to ten minutes.

JOHNSON'S RADIATOR CEMENT

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Johnson's Radiator Cement contains no powders, cement or anything which can coat or clog the cooling system. It blends perfectly with the water until it reaches the leak—just as soon as it comes in contact with the air it forms a hard, tough, pressure-resisting substance which is insoluble in water, making a permanent seal.

If your dealer cannot supply you, send us $1.00 and we will forward you by prepaid express a pint can of Johnson's Radiator Cement.

Quarts, $1.75 Pints, $1.00 Half-pints, 65c

Write for Our Folder on "Keeping Your Car Young"—It's Free

S. C. JOHNSON & SON. Dept. M.A. RACINE, WIS.

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Advertisers' Index—Next to Last Page

The New Improved
UTILITY Universal Rim Wrench
Now Belongs in Every Tool Box and Every Garage

New Improved Price Still $1.50

The UTILITY Rim Wrench is now the most beautiful and serviceable tool for use about the motor car—whether in the tool box of the car owner or in the public repair shop or garage.

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MOTOR AGE

Published Every Thursday by the
CLASS JOURNAL COMPANY
Mallers Building
CHICAGO ILLINOIS

Entered as Second-Class Matter September 19, 1899, at the Postoffice at Chicago, Illinois, Under Act of March 3, 1879—Member of the Audit Bureau of Circulations—Copyright, 1917, by the Class Journal Co.

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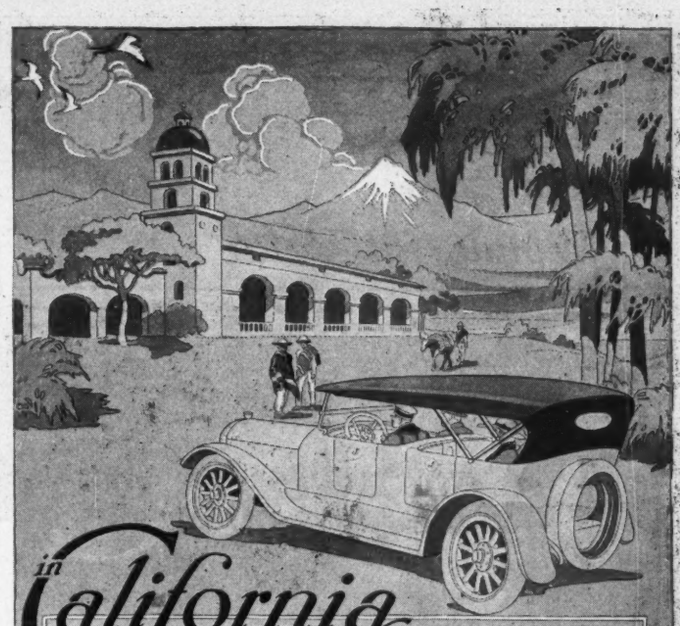
COMING!

These rare days that breathe of spring are great little accelerators, aren't they? You begin to think about overhauling your car and vacations and similar joys. Well, MOTOR AGE is planning to help you do all these things. First will come the issue in which you can learn just how to go about the spring overhauling and how to do a complete job. Then there is the touring issue, which this year, in line with the spirit of the times, will be more practical even than last year. If you want to know just what you will get from that issue, be sure to watch MOTOR AGE closely from now on. The touring issue is not far off and every page in it will contain something of value.

Coming soon—MOTOR AGE annual touring issue.



in California

—where every day is a day in June, cars congregate from every section of the continent to escape the rigors of our winter climate.

Motor Cars, whose owners can afford to choose their own climatic conditions are usually equipped with—

GENUINE
Pantasote
TOP MATERIAL

—the one top material which is able to withstand California climate—and for that matter any climate whether damp or dry, hot or cold in the extreme.

Pantasote, the most expensive of all top materials, is always associated with the type of car whose makers believe the best is wisest under all conditions, and who can afford to pay for the best.

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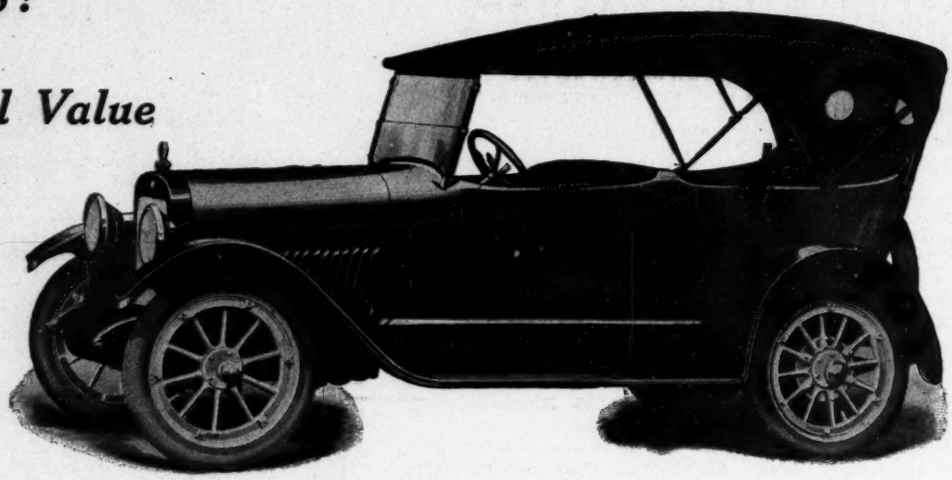
A car of Wonderful Value

No other car compares with the Elcar at the money. None so handsome! None so roomy! None so well built! None so economical! Naturally it is a good selling car. Our increased production enables us to accommodate a few more live dealers in picked territories.



Big Car Comfort! Small Car Upkeep!

ELCAR

Elcar Four Cylinder Touring Car and Roadster, $1095

Elcar Six Cylinder Touring Car and Roadster, $1295

The new Elcar is the **roomiest car** with the **longest wheel base** of any selling at as low a price. Long flexible springs and deep upholstery add to the comfort. Ride all day and you won't be cramped.

You secure this comfort for moderate upkeep cost. 18 to 24 miles are averaged to the gallon of gasoline. 1000 miles to a gallon of oil is the rule rather than the exception. Tires give exceptionally long service due to light weight and correct balance. Repair expense runs low—the Elcar is quality built. Every part is 150% strong.

You will be proud to own an Elcar. The lines are long and graceful; the body work high grade; the finish beautiful and durable. The motor is speedy, with abundant power for the hard pulls. It is a car that will serve you economically, dependably and long.

Investigate the Elcar at our nearest dealer. We'll gladly write you his name, if you don't know him.

CATALOG ON REQUEST. Write for catalog illustrating and describing the six new Elcar models. We gladly mail it to anyone interested.

Elkhart Carriage & Motor Car Company

C-781 Beardsley Ave., Elkhart, Ind.

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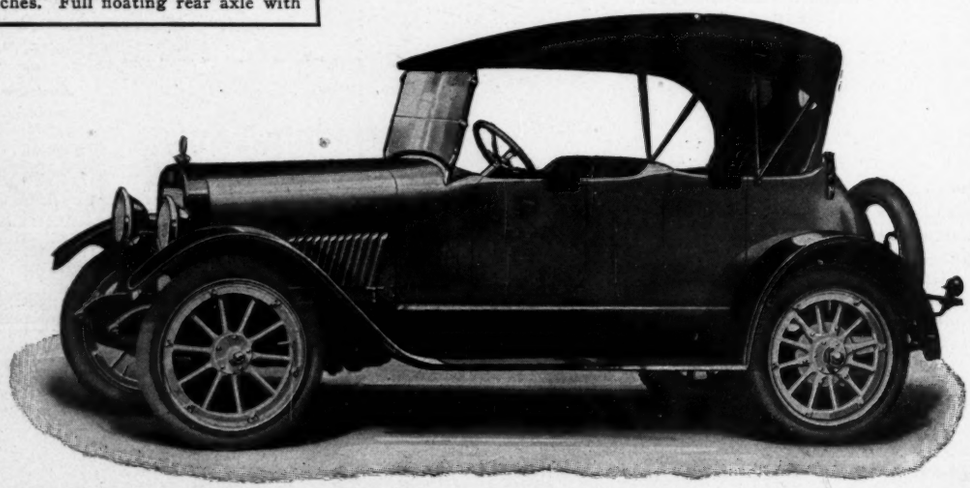
Four-cylinder models, 37½ horse power at 2100 r. p. m. Six-cylinder models, 40 horse power at 2100 r. p. m. Two unit electrical system. Long wheelbase, 116 inches; road clearance 10½ inches. Full floating rear axle with spiral bevel driving gears. Timken Roller Bearings front and rear. Double universal drive; tubular propeller shaft.

A wonderfully easy riding semi-elliptic spring suspension. Roomy and comfortable bodies of beautiful design and durable finish, new "Cathedral Pipe" upholstering. Equipment complete, even to motometer.

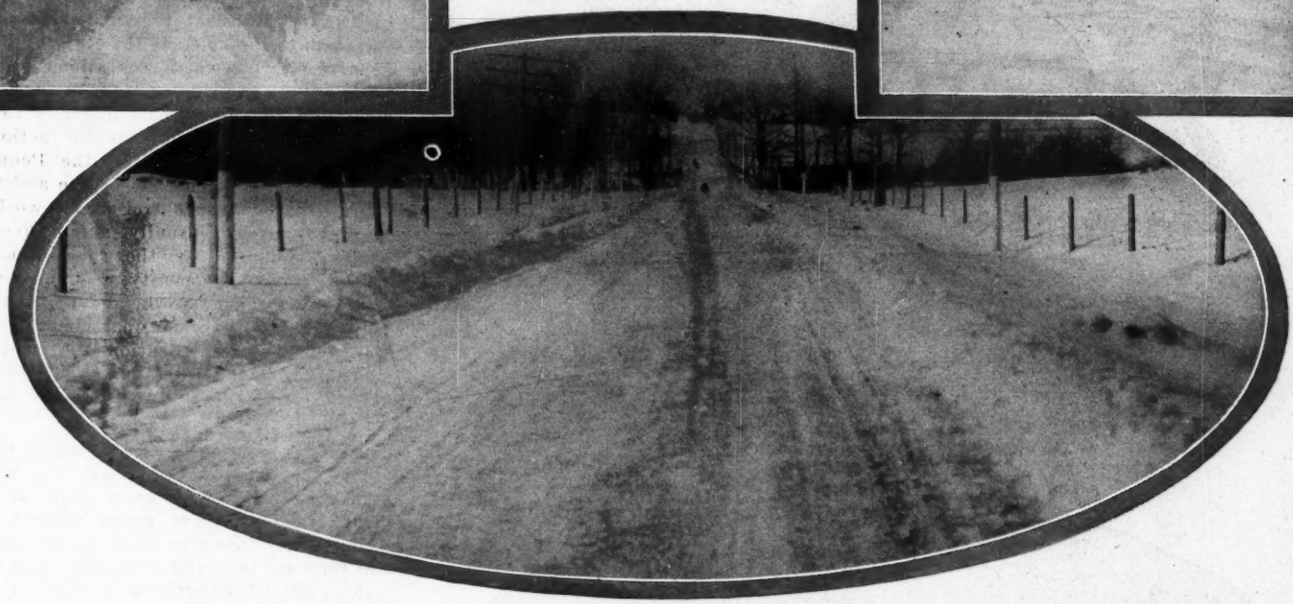


Vol. XXXIII, No. 9 Chicago, February 28, 1918 $3.00 Per Year

MOTOR AGE

Road Insurance for Winter Traffic

Here are shown the old and new ways in which this road, ready for passage of trucks, may be kept open. The ways are shoveling and motor trucks with plows



By Ruth Sanders
Motor Age Editorial Staff

THIS is the time of the year when state, county and municipal organizations, as well as good roads associations, should get together and map out the work for the coming year. It is a more opportune time even this year. The heavy snows of the winter, coupled with the intense freight congestion of the railroads, have made imperative the utilization of all our means to keep highways open every day in the year. That this can be done has been demonstrated this winter. Pennsylvania has kept open a route that crosses two mountain ranges within the state. Ohio has kept open a road clear across that state as well as other main routes within its borders. Michigan has made a large appropriation from its $5,000,000 war fund to keep the snow from retarding the progress of truck travel. Connecticut has kept its roads open. Lack of open roads has done more than hold up shipments of motor cars and trucks which would have used them in even greater numbers than they did had the highways been passable. Lack of open roads tightened the food pinch. The farmer had a hard time getting his produce to market. The wholesaler who is used to making shipments to outlying suburbs by motor truck found himself in many cases unable to make headway against the heavy snowdrifts.

The need of the nation for year-round highways was never more imperative. We must get food to the seaboard for shipment to our boys in France. We must use trucks in short hauls of food and merchandise, which otherwise could not be distributed. We must get the cars and trucks from our factories, as they are turned out, to various parts of the country so that the army of motors can do its part in supplying the different parts of the country with food and other necessaries.

Now is the time to plan for next winter. What is your community going to do to keep the roads clear for the passage of traffic, motor traffic in particular, next winter? Is your state highway department ready to cope with the heavy storms

Commonwealth of Pennsylvania
STATE HIGHWAY DEPARTMENT

FORM No. N 620
SNOW
~~ROAD AND BRIDGE~~
EMERGENCY REPORT

DATE 12-8-17 | ROUTE 119
COUNTY Bedford | APPL. ---
DIST. 11 | CHARGE NO. 50505

From Sta.	To Sta.	Drifts	Remarks. 6 P. M.
270	280	3½'	Began snowing 12-7. 4 PM, con
308	314	4½'	tinuing until 12-8. 2 PM.
317	319	2½'	High winds made removal of
383	387	4½'	drifts impossible until 5:30
450	462	6'	PM. Have truck snow plow, drag, road machine and 18 men working. Will work night shift.

~~Stations between which traffic is detoured~~ ..... ~~Length of detour~~ ..... ~~mi.~~ Approximate date road will be opened 12-9 PM

Condition of ~~detour~~ roadway: Average depth of snowfall 12 inches. Expect to get 8 ft. width open by tomorrow afternoon.

~~Date detour becomes effective~~ ..... Date road opened for traffic closed

Signed Samuel Corley Title Caretaker

This is a reproduction of a report made on a postal card in accordance with the Pennsylvania system of keeping the roads open. The information is charted at the main office

Hand shoveling through short spurs, the method used prior to mechanical devices

Road machine in operation to clear snow. It is found very effective here

of this winter should they return next winter?

That many less trucks would have reached the seaboard, and from there France, this winter had it not been for the organized efforts of the communities and states along the route from the Mid West eastward is a statement that needs no argument. Through the roads that were kept open our boys in France have been supplied with the motive means for better transportation of their munitions, their equipment and their foods, and aid has been given our allies.

How to Do It

How can a state department or other organized working body keep the roads open every day in the year? Look at the system followed by Pennsylvania. The route kept up by Pennsylvania for the passage of the motor trucks bought by the various divisions of the War Department under their own power from the factories to the Atlantic overland covers a distance of approximately 225 miles from the Ohio state line through Beaver Falls, Pittsburg, Greensburg, Bedford, McConnellsburg, Chambersburg, Gettysburg and Littlestown to the Maryland state line. How can this be done? This is the way it is done.

First: Arrangements are made with the weather bureau office closest to the state highway department to wire the weather forecasts to the office of the state highway department, by which conditions can be anticipated and instructions issued immediately to the various districts to organize men and equipment for action.

The field organization of the Pennsylvania department consists of the assistant engineer, who has control of all work in several counties, usually about five in number, followed by the superintendent of highways of the county, who has charge of all maintenance work, and under them come the gang foremen, patrolmen, laborers, etc. This organization has complete charge under the direction of the second deputy commissioner in charge of maintenance.

Second: Stationed at the larger towns along the line of this route are motor trucks equipped with snow plow attachments, road machines, drags, shovels, etc. About thirty-four men make up the patrol, and they are in constant service, each man looking after his particular section. Emergency conditions of consequence are reported to the district head or the superintendent, who reports by wire or telephone to the main office direct. The caretaker is empowered to organize forces, if need be, to take care of conditions until the arrival of the superintendent. If the conditions are unusual, the superintendent reports by telephone to the assistant engineer, who arranges to inspect and handle the work accordingly.

Third: Report is made by the caretaker by wire or telephone, and a postal card report, such as is illustrated, follows. This information is charted as soon as received. In the end all the information on the job is charted. If the drifts are abnormal and the road is not open within 24 hr., the office must be advised by wire.

The first snowstorm of consequence in Pennsylvania came on Dec. 7 and 8. For many miles drifts averaged 3 and 6 ft. deep. The work was begun by breaking a track through the drifts with teams and drags. Then the road machines or trucks with plow attachments and shovelers followed. Where turn-outs were made the road was widened 14 or 16 ft. The entire width of roadway was opened finally so traffic would not track and cut through the road surface during periods of freezing and thawing. The snow at first was removed to within 3 in. of the road surface and what did not melt was removed altogether afterward. After a track was broken through the deep cuts shoveling was used.

Fourth: When a section is opened shovelers follow, cutting openings from the side to the ditches at intervals. Then the road is turned over to the caretaker or patrolmen for drainage details.

Use of Snow Fences

Observations in Pennsylvania since 1913 indicate certain locations where snow fences are economical, and some of the fence has been put in, though the entire fencing will not be complete until next season.

Day and night shifts were worked at certain sections, where there was the greatest need. The organization started with 200 men and the following equipment:

Seven motor trucks and plows,
Twenty-two road machines,
One hundred and five teams,
Three tractors.

If you haven't got these or the means of obtaining them all pull out the equipment you already have and use:

Road drags,
Road graders,
Horses.

Road drags and road graders are in nearly every county and there are plenty of men who can operate them. Horses would be much better off used in this work rather than idle in the stalls.

The main essential is to get started quickly. As soon as the snow begins to fall, put your forces to work. Keep at it day and night, if there is need. This simplifies matters by eliminating accumulations. Remember the bundle of sticks. It is easier to clear away one snow each time than it is to clear away two or more at one time.

It would be good economy to keep the roads open the year round. It means a big saving in maintenance costs. A snowfall permitted to remain on a road gradually will sink in, until the whole construction is saturated. This leads to rapid disintegration, and the road is in poor shape for traffic when spring thaws reopen it.

The Government realizes the need of the road that is open every day in the year. This need is imperative if the great trains of army trucks are to go overland under their own power. That the Government is willing and anxious to do its part in helping get ready for continued driveaways next winter is apparent in the accompanying diagram, which information is being sent out now by the office of public roads and rural engineering. It is for the removal of snow from highways so that traffic can continue through fair weather and snowy. It gives the minimum clearance through snowdrifts required on truck train roads, a roadway of 7 ft. with the snow sloping at an angle permitting the passage of army trucks.

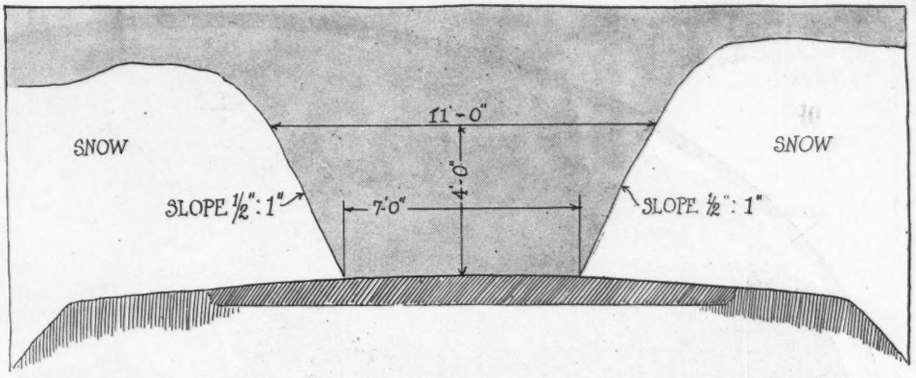


Diagram showing minimum clearance allowed for the passage of trucks. This is being circulated by the office of public roads and rural engineering throughout the country to open more roads

Comparison with the man and car show the deep drifts opened for traffic

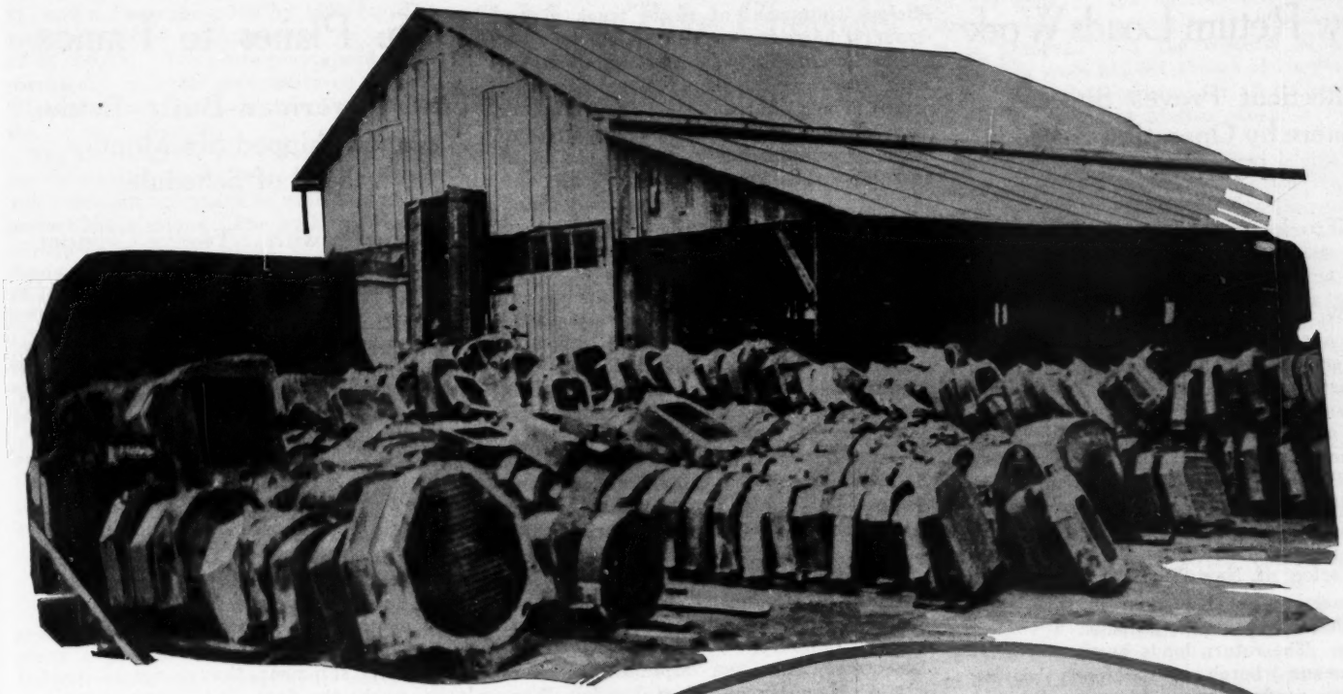
Tractors can do a big part in keeping the roads open the year round

Elsewhere in this issue are accounts of the truck service maintained by a tire maker over a route of 740 miles, the return loads bureaus of Connecticut and the arrival of other war trucks on the Atlantic seaboard. All these are due to organized effort to keep the roads open, an organized effort that must become more universal next winter if we are to keep up the steady stream of trucks to the seaboard necessary for us to play our part in the world war to its fullest.

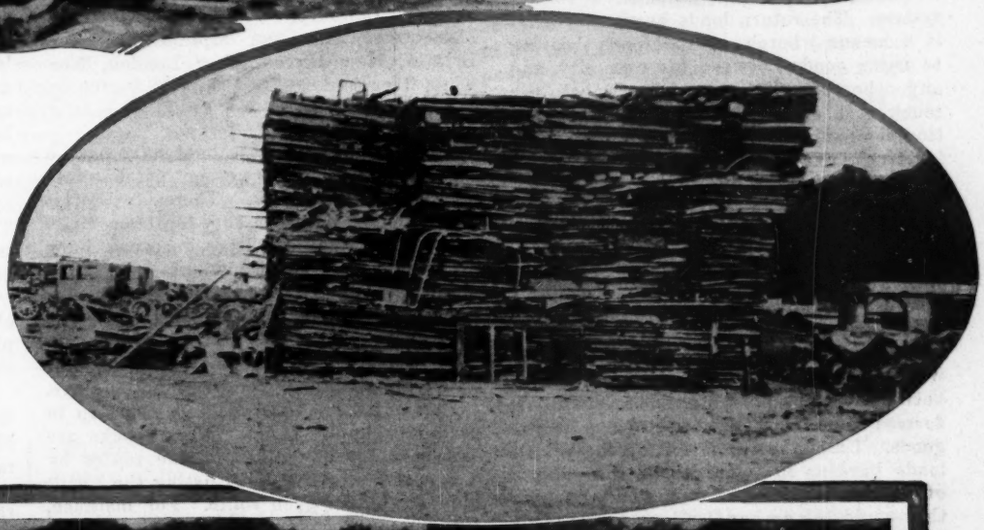
MOTORS IN FIGHTING AND HOW SOME ARE RECLAIMED FOR WAR

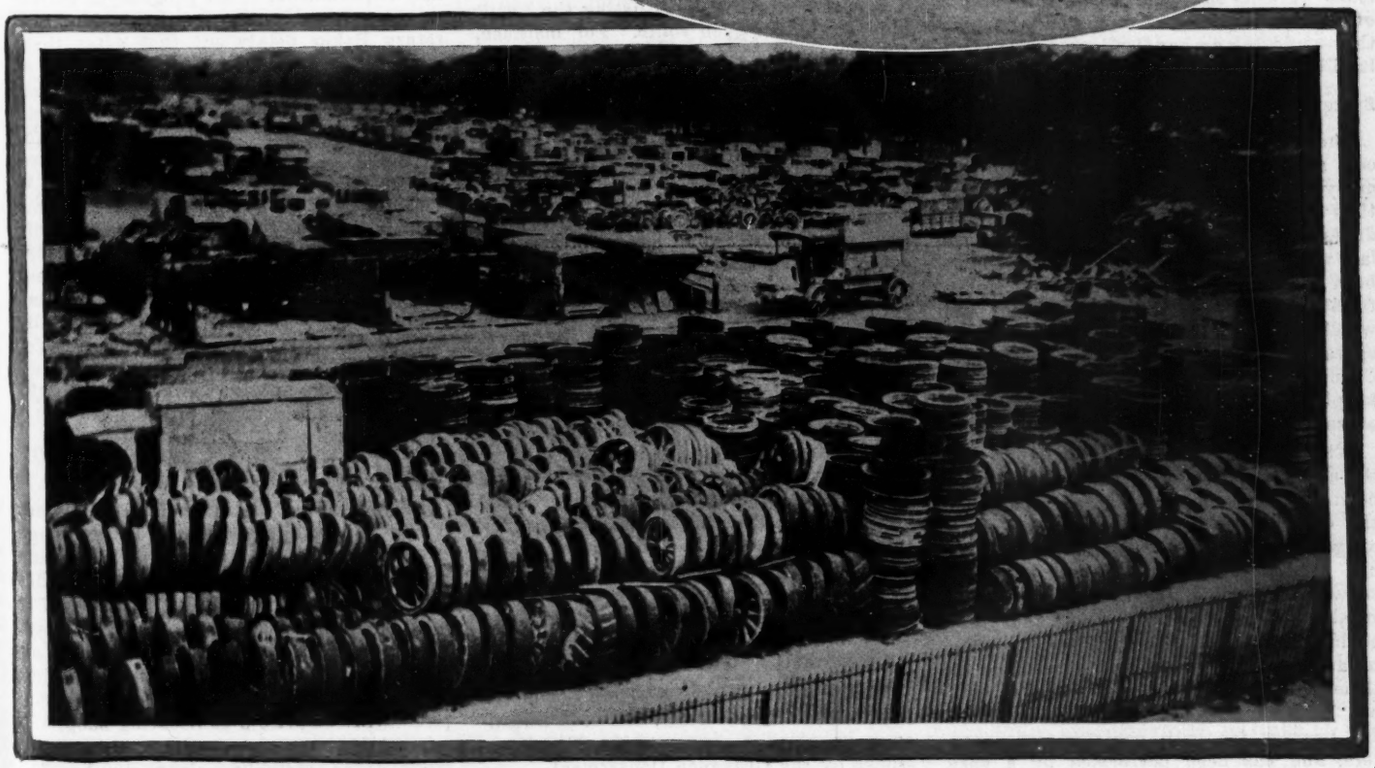
German prisoners are building roads in American camps in France. A small wage is paid to them for this work. The photograph shows them building a road through the trap-shooting range in an American camp. The prisoners seem glad to have the monotony of the prison barracks broken by the work, though naturally one could not expect them to labor with any grace for the U. S.

The French plane at the top is maneuvering for position preparatory to swooping down on the German plane. The photograph was made by an observer in another French battleplane and shows, better than the usual picture, how the warplanes are handled in battle. With the skill of the photographer-observer who is now so integral a part of air battles it is possible to know how a battle is going to a degree



That nothing is wasted from motors scrapped by war is evident from this page, which shows how the parts are assembled and stored for future use. This pile of radiators will be used on other cars. For the time being, however, they are in the scrap yard at Vincennes, near Paris. The different parts are gathered into a gigantic scrap heap at the ordnance depot and sorted out, each being stored with the others of its kind, ready to go into active service





How Return Loads Work

Connecticut Proves Success of System by Operating Bureaus in Fourteen Cities

700 Trucks Are Listed as Available for Haulage

NEW YORK, Feb. 22—How the return loads system can be put into practice with success for all concerned is being demonstrated in Connecticut, which has fourteen return loads bureaus in as many cities, at which 700 motor trucks are listed. Just how the plan is working out was told by Williams S. Conning, chairman of the committee on motor truck transportation of the Connecticut state council of defense in an address before the Highway Traffic Association of New York Tuesday night.

Connecticut is the leader in this work. No other state has established a similar system. The return loads bureau, in brief is a means whereby any shipper desiring to move goods between his own city and any other city immediately may get into touch with either motor truck transportation companies or private individuals owning trucks available for this work either on contract or load basis.

The need for these bureaus is evident, particularly since the acute railroad congestion resulted in great amounts of goods which could not be shipped by rail. Some of these goods were finished products to be hauled to shipping points to begin their final shipment to destination, while others were partly finished-products to be hauled between various plants, each of which performed some one or two operations on the goods. Until the formation of the return loads bureaus in Connecticut, the makers of that state did not know what concerns they could ask to handle these goods overland by motor truck.

System a Success

The system has proved a very great success and a very great convenience for the many manufacturers of Connecticut, who thus have been able to move many hundreds of thousands of tons of freight since last winter which otherwise could not have been taken from their shipping room platforms. Perhaps the most important aid which has been rendered has been the cooperation extended by Charles J. Bennett, Connecticut highway commissioner, in keeping the Connecticut state roads free of snow during the winter months.

While New York, which ranks first in the number and value of war contracts, has hesitated in keeping its roads open for the delivery of the many million dollars of goods made in the state, Connecticut has kept its main highways cleared of snow so efficiently that farmers in the rural districts have complained that they could not run their sleighs over the roads because there was not sufficient snow on them. The cost of this snow removal work has been borne out of the funds collected for licenses for both vehicles and operators, and has been performed by a very efficient equipment of motor truck plows, scrapers, horse teams and an efficient organization of highway department workmen. In explaining the development of the return loads bureau idea, Mr. Conning pointed out that the chambers of commerce or war bureaus in each of the cities has undertaken the work patriotically and has even had its telephone number listed a second time under the heading "Return Loads," so that any truck operator arriving in any city in the state in which one of the bureaus was established could immediately get in touch by merely asking the telephone girl for "Return Loads." He also brought out the fact that the return loads bureaus' main function has been to get the shippers and transportation concerns together, leaving to themselves all questions as to the rates charged, the reliability of the haulage concern and the responsibility on the part of.

More than 700 trucks of 1-ton capacity and over are now listed in the fourteen return load bureaus established in Connecticut. Cities which have these bureaus in actual operation are: Bridgeport, Bristol, Danbury, Greenwich, Hartford, Manchester, Meriden, Middletown, New Britain, New Haven, New London, Norwich, Stamford and Waterbury.

Forty-eight Routes

The only city which should have such a bureau and which has not yet put one into operation is Norwalk. There are forty-eight routes between the fourteen cities which have established the bureaus. Each of these routes are drawn up on a large map posted in the office of each of the bureaus, so that each bureau may know the routes in other parts of the state over which some of the 700 motor trucks now listed are available for overland haulage.

Furthermore, the head of the bureau in each city knows exactly what trucks are available for any other of the routes by a master file of the cards listing the available trucks for each route. For instance, the bureau in New Haven knows what trucks are available for haulage work between Danbury and Bridgeport or between Hartford, South Manchester or Norwich.

As practically all the main highway routes are included in the routes listed by the return loads bureau, the system offers a real network of routes to supply practically every one of the manufacturing centers of the state.

Each motor truck listed is placed on a card with the name and address of the owner, the size and capacity of the truck, the kind of goods it can most economically haul and the number of the route over which it operates.

All the trucks which run on any particular route are given the same route number and are kept in a file in which the route numbers are arranged numerically. This is a ready means of reference for any route, since each one of the fourteen bureaus is supplied with a complete list of the trucks available on all routes.

COMMERCE GETS WAR ORDER

Washington, Feb. 21—The Commerce Motor Truck Co., Detroit, has been awarded a contract for 1500 1-ton Commerce trucks by the Ordnance Department.

U. S. Planes to France

First American-Built Battleplanes Shipped Six Months Ahead of Schedule

Equipped with Twelve-Cylinder Liberty Engines

WASHINGTON, Feb. 22—The first American-built battleplanes are today enroute to the front in France. These planes are equipped with the first Liberty airplane engines from machine production. One of them in a recent test surpassed all records for speed and climbing for planes of battle type. Engine production, which began a month ago, is now on a quantity basis and the peak of production will be reached in a few weeks. Only the twelve-cylinder type is being made, as developments abroad have made it wise to concentrate on the high-powered engine instead of the eight-cylinder one.

This first shipment, though not in itself large, marks the final overcoming of many difficulties met in building up this new intricate industry. The great remaining problem is to secure the thousands of skilled mechanics, engine men, motor repairmen, wood and metal workers and so on needed to keep the planes in perfect condition. The engineering and mechanical force at the airdomes, the flying fields and the repair depots, both here and behind the lines in France, is a vital industrial link in the chain to air supremacy. Without them the planes turned out are useless and the flyers helpless.

These statements, issued by Secretary of War Baker, are designed to give as complete a picture as permissible under military requirements of the progress of our air service. In reviewing the air problem, Secretary Baker points out that after three years of warfare the total number of planes able to take the air at any one time on either side of the western front, has not been over 2500. This, combined with the fact that forty-six men are required on the ground for every plane in the air, gives a better perspective of European aviation conditions than commonly has been possessed on this side. Every plane in the air requires two replacement planes on the ground and one training plane for every pilot who eventually reaches the front with a spare engine for each plane. The first American-made battle planes were not due in France under the original schedule until July.

PLANT FOR FORD CHASERS

Detroit, Feb. 25—Henry Ford will erect a new shipbuilding plant at River Rouge to complete the manufacture of submarine chasers. Construction work on the buildings has been started, and it is expected it will be completed in seventy-five days. There will be five buildings, covering an area of 5 acres and costing, including equipment, approximately $2,000,000. The plant will comprise a fabricating shop, 150 by 450 ft., where parts for hulls will be made; three assembling plants, 100 by 1700

ft., and a fit-up shop, 100 by 1500 ft. The buildings alone will represent an outlay of $1,000,000. The powerplants and other machinery will be manufactured at the Highland Park plant of the Ford Motor Co.

The material for the chasers will enter the fabricating plants, from which the hulls will come out on tracks to each bay of the assembling stations. The hulls then move along, parts being added until they are ready for the transfer table, from which the hulls drop into the water by a hydraulic lift. After the boats are floated the installation of motor parts, boilers and armament begins. The last thing added is a wireless. The boat is then ready for the submarine zone.

When the plant is complete and in operation it will give employment to from 10,000 to 15,000 men. A canal, or slip, from the Rouge river to the plant is now being dredged.

U. S. WANTS MOTOR ROUTES

Harrisburg, Pa., Feb. 26—Special telegram—The Department of Agriculture plans a preliminary survey of the motor freight routes now operating to determine the feasibility of a campaign for rural motor truck express service connecting cities with farm centers. Charles J. Brand, chief of the bureau of markets, is directing the investigation. The project was proposed by the Highways Transport Committee, which already has started investigation. Rural express service around Baltimore and Washington plans include study of operating costs of trucks now doing rural express, volume of business done and territory served. If found profitable, demonstration service lines will be started.

MAXWELL PRICES INCREASE

Detroit, Feb. 25—The prices of the Maxwell passenger cars and trucks will be increased on March 1 as follows:

PASSENGER CARS

Model	New price	Old price
Touring car	$ 825	$ 745
Roadster	825	745
Touring car with winter top	935	855
Roadster with winter top	910	830
Berline	1,175	1,095
Berline with wire wheels (optional)	1,275	1,195
Sedan with wire wheels	1,275	1,195
Chassis with cowl	735	655
Chassis with commercial delivery body	810	730
1-TON TRUCK CHASSIS		
Chassis only	1,085	985
With cab and windshield	1,125	1,025
With stake gate	1,180	1,080
With combination box stake	1,175	1,075
With combination box	1,135	1,035
With canopy body	1,195	1,095

The prices for Canada and foreign countries will remain the same.

BID ON POSTOFFICE PLANES

Washington, Feb. 22—Three bids were received today for the five airplanes for the Postoffice, New York-to-Washington aerial service. These were received from the United Eastern Airplane Co., $59,000, delivery in thirty days; the Standard Aero Corp., $68,000, delivery in sixty-three days; the West Virginia Aircraft Co., $72,500, delivery in ninety days.

Second Assistant Postmaster General Otto Praeger left yesterday for a trip through Philadelphia and New York for inspection of landing sites for the airplanes.

G.M. to Take Chevrolet

By New Division General Motors Output Yearly Will Total 400,000 Cars

Prices Will Range from $685 up to $2,800

NEW YORK, Feb. 23—The Chevrolet Motor Co. is soon to pass out of existence as an independent producing company. Under the terms of a recommendation submitted at the annual meeting of the General Motors Corp., and soon to be ratified, it will become a division of the General Motors Co. and its status will be the same as that of other General Motors divisions such as Buick, Cadillac, Oakland, Oldsmobile and the other large parts making concerns. Like these companies it will go on producing cars as in the past and its methods of distribution for its products will not be altered.

When the changes are completed, the General Motors divisions will have a combined output of close to 400,000 cars a year with cars in every price class except the very lowest, ranging from the smallest Chevrolet at $685 to the Cadillac at $2,800. Chevrolet alone accounts for 125,000 cars of the 400,000.

The Chevrolet Motor Co. owns a controlling interest in the General Motors Co., but when the new plan becomes effective there will be only General Motors stock outstanding. The Chevrolet company owns 54 per cent of the outstanding General Motors stock amounting to 450,000 shares. It is proposed that the General Motors Corp. turn over 282,684 shares of its stock to the Chevrolet company for all its assets except the General Motors stock it now owns.

In other words, when the deal is finally put through, the assets of the Chevrolet company will consist of 732,684 shares of General Motors stock. Against this there will be outstanding some 640,048 shares of Chevrolet having a present par value of $64,004,800. Chevrolet will own one and a seventh shares of General Motors stock for every one of its own and will become the owner of 732,684 General Motors' shares out of a total outstanding of 1,108,-264.

Durant Still Head

W. C. Durant, who fathered and developed the Chevrolet Motor Co. will continue head of the General Motors Co. and chairman of the board of directors, in which there have been some changes. E. I. du Pont de Nemours & Co. have acquired substantial stock holdings in both Chevrolet and General Motors, both of which companies are controlled by the du Pont company and Durant, who is the largest single stockholder. L. G. Kaufman has resigned as a member of the finance committee but remains a director, and the du Pont company now is represented on the Board of Directors by J. A. Haskell, J. J. Rafkob, P. F. du Pont, Irenee du Pont and Henry F. du Pont, the last two being elected directors last Thursday.

The General Motors Corp. was formed Sept. 16, 1908, and at present owns the entire capital stock of the following divisions or manufacturing companies: Buick Motor Co., Cadillac Motor Car Co., General Motors Export Co., General Motors Truck Co., Jackson-Church-Wilcox Co., Oakland Motor Car Co., Olds Motor Works, Northway Motor & Mfg. Co., Weston-Mott Co. It also owns a majority of stock interest in the Champion Ignition Co., Flint, and operates under lease the McLaughlin Motor Car Co., Oshawa, Ont., and the General Motors, Ltd., which is located at London, in England.

Chevrolet Formed in 1915

The Chevrolet Motor Co. was formed Sept. 23, 1915, and owns all of the outstanding capital stock of the Chevrolet Motor Co. of New York City, Chevrolet Motor Co. of Michigan, Mason Motor Co. of Flint, Chevrolet Motor Co. of Toledo, Chevrolet Motor Co. of Bay City; it has profit-sharing relations with Chevrolet Motor Co. of Canada, Chevrolet Motor Co. of St. Louis, Chevrolet Motor Co. of California, Chevrolet Motor Co. of Texas. In addition to its 450,000 shares of General Motors stock, the company also owns 106,-000 shares of common stock of the United Motors Corp. and 13,650 shares of Scripps-Booth common.

Due to the fact that this large block of United Motors' stock is owned by Chevrolet, and because the same interests control both General Motors and United Motors, there is talk of having General Motors take over United Motors in the same way it has taken over Chevrolet, to make of it another General Motors division.

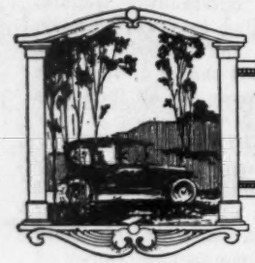
Ford Prices Climb

DETROIT, Feb. 23—Ford has raised the price of its cars, increase effective today, as follows: Chassis, old price $325, new price, $400; roadster, old price, $345, new price, $435; touring car, old price $360, new price, $450. The price of the truck chassis is unchanged.

The Ford company has been writing with every order the stipulation that prices of Ford cars may be increased without notice and that the cost may even be increased after acceptance of an order. Under the order plan purchasers either can take the car at the new rate or cancel their order and have the deposit refunded.

As stated before in these columns the production of the Ford company has been reduced from 3000 a day to 1500 a day. The economics of the Ford factory are such that it is natural that profits are considerably less with the reduced output. In other words, the Ford car could not be manufactured at a profit under present material conditions when the output is 1500 per day. For that reason it is necessary to increase the price as stated.

Dealers throughout the country are commenting that the raise in price of the Ford car will bring it into a more closely competitive field. There is little fear, however, that even with the keener competition on the increased price that the Ford company will be able to meet the demand for its cars.



EDITORIAL PERSPECTIVES

Year-Round Roads Imperative

NOW that the highways of the northern part of the country are becoming cleared of snow so that movement of war materials and domestic supplies are proceeding over the roads in a volume something near nomal, we cannot sit back and wait until our motor traffic is tied up again by next winter's snow fall before taking steps looking toward some method of keeping the roads in condition the year round. It will snow again next winter. Perhaps there will not be as much as there was during the season just past, but we cannot hope that without some well-organized efforts the movement on the roads can continue unhampered throughout the winter.

THIS is the time for the state authorities, the roads organizations, the civic bodies, the motor organizations and patriotic citizens along all our main arteries of motor travel to commence getting their snow removal organizations into shape for another strenuous winter. One of the chief difficulties this year was the lack of proper equipment. You cannot wait until the roads become blocked with snow to order your equipment for keeping them open. Your snow plows and other equipment must be on the ground before snow flies. What is more important, your organization must be in working order before it has to be rushed into service.

IT was lack of preparedness that prevented complete opening of the roads this year and held back the delivery at the seaboard of so many trucks and other supplies which were so badly needed at the front. This interruption of travel struck serious blows at the Nation's war preparations. It added to the food shortage, deranged business and was the direct cause of hardship and financial loss. Foodstuffs could not be hauled to market by the farmer, nor could they be delivered to the railroads. Tons rotted for lack of delivery facilities. Short-haul freight that could not be handled by overcrowded railroads, but which could have been handled by motor had the highways been passable, was piled up at terminals to aggravate that already immense congestion.

To keep all main roads open all the year round for the increasing traffic they must bear in war times has become a patriotic duty.

THE winter just past was the first in which it was imperative that roads be kept open—at the same time weather condition were such as to make this the most difficult that it has been for many seasons. In one state at least where it was most important a brilliant success was recorded and how the work was organized is told in the leading story in this issue. The Highways Transport Committee working in Washington to aid the Government in solving problems of freight congestion, gave much assistance in this emergency.

THERE was special need of help in making passable those roads traversed by convoys of motor trucks delivered over the road by Government orders. But, according to Roy D. Chapin, chairman of the Highways Transport Committee, the problem is one that calls for more than emergency efforts in isolated spots. It must be dealt with comprehensively and preparation must be made in advance, so that there will be the certainty that the roads will be open every day.

PENNSYLVANIA this winter succeeded in keeping many of her important roads free of snow. Ohio kept a road clear across the state, as well as other important routes. Michigan made an appropriation from her $5,000,000 war fund to remove snow from all the main routes within its borders but did not get into action with it in time to accomplish as much as would have been possible had preparation for the emergency been made earlier.

THAT there will be an enormous development in highway traffic during 1918 is certain. The roads of the Nation must be used for the movement of a great volume of freight forced off the railroads by the need of transporting war supplies. A great proportion of the huge increase in production brought about by war must be diverted to the roads at some stage of its handling.

KEEPING the roads clear every day is a part of the war program. It is up to the state associations, the civic bodies and the motor clubs to organize now and get equipped for next winter's battle with the snow.

The Car's Brakes

UNFORTUNATELY the motoring public pays little attention to the braking system of a car. This fact generally is emphasized in buying cars. The prospect is interested vitally in the car's power equipment, tire life, body finish, etc., but seldom inquires about the effectiveness of the brakes.

SAFETY in a motor car is directly proportional to its braking system. Locomotive engineers are concerned fully as much about their air brakes as they are to the alacrity with which the engine responds to the pull of the throttle lever. Car buyers, especially those who never have owned a car, take a great deal for granted. Some look upon the modern car as being irreproachable. True, cars are built along general lines; all have engines which look pretty much alike, brakes on the rear wheels and similar features, yet it is equally true that cars do not all handle alike. Some accelerate faster; likewise brakes are more effective on some cars than others.

NO matter how much the prospective owner may have become interested in a car's engine performance or its body design, he should make sure the brakes are liberal in size. They may be the means of saving his life. It is a great pleasure to sit behind an engine that pulsates with an abundance of energy, but it is just as great a satisfaction to feel the car slowing down smoothly but unquestionably with a good set of brakes. See that there is enough power to carry you over the steepest hill, but be doubly sure that you can stop quickly and surely.

War Trucks at Seaboard

First of Several Trains from Detroit Reach Atlantic in Eight Days

Average for 575-Mile Trip Is 72 and Highest, 97.4

WASHINGTON, Feb. 21—The first truck company of the several companies which left Detroit in the last ten days arrived at the seaboard yesterday with its full quota of thirty trucks. The trip was negotiated in eight days, making an average of 72 miles a day for the 575-mile journey. The highest day's mileage was 97.4 miles over smooth straight roads and 85.4 miles through the mountains. The second truck company reached Bedford, Pa., Wednesday night.

Scenes on the route between Detroit and the Atlantic, snow-blockaded roads over which the war trucks battled their way from factory to seaboard

U. S. ORDERS 3500 TRAILERS

Detroit, Feb. 25—The Government has let contracts for a total of 3500 trailers, 1500 from the Dort Motor Car Co., Flint, Mich., 1000 from the Ohio Trailer Co., Cleveland, Ohio; and 500 each from the Columbia Motors Co., Miami Trailer Co., Troy, Ohio, and Rogers Bros. Co., Albion, Pennsylvania.

It is expected to have half the Columbia order delivered early in March and the complete order on the way by April. The factory is preparing plans to readjust the factory forces that will permit the building of the trailers without undue interference with the manufacture of passenger cars. Additional men have been employed. The Government has asked the company to arrange its factory forces and equipment to enable it to take care of subsequent orders. The officials state that their plans are so arranged that they can fill all the orders for the Government as fast as the latter requires them and at the same time continue their previously arranged program for the building of passenger cars.

TRAINING F-W-D OPERATORS

Clintonville, Wis., Feb. 22—The Four-Wheel-Drive Auto Co. now is manufacturing between twenty and twenty-five complete 3-ton trucks every day. The Government has erected barracks near the factory where over 200 officers and men of the ordnance department of the Army make their headquarters when receiving instructions in the operation and care of the F-W-D trucks in the established school of the plant. The course lasts four weeks for the men and three weeks for the officers.

KISSEL GETS F-W-D ORDER

Hartford, Wis., Feb. 22—The Kissel Motor Car Co. has been awarded a Government contract for F-W-D trucks through the Four-Wheel-Drive Auto Co., Clintonville, Wis. It is stated that the contract will aggregate $7,500,000.

175,000 Fall Mechanics

Newly Trained and Technical Men Will Be Ready for Army by Oct. 1

Intensive Education for Drafted Soldiers of U. S. A.

WASHINGTON, Feb. 22—Altogether 175,000 newly-trained mechanics and technical men will be ready to answer roll call Oct. 1 for occupations required by the United States Army. This estimate is the result of questionnaires mailed and personal visits to 143 colleges, trade schools and allied institutions throughout the country by the Federal board for vocational education. Forty-two institutions have signified their willingness to begin work at once, and seventeen state they will be able to give instruction by May 1. The plan is to take drafted men of the first class who have signified their willingness and give them intensive training. The program of the Federal board, which was created prior to the war to enlarge educational facilities for students of mechanics, industry and agriculture, calls for the complete diversion of the available institutions of the country to war vocational training, the board acting for the newly created war educational committee of the War Department.

The schools are expected to train men with various assets of knowledge and experience to do the work demanded in various Army occupations in courses of two months' duration. It is not expected at the outset that novices can be made into experts in this length of time.

The Federal board now has representatives traveling through the country investigating both public and private schools, including those taking in all automotive trades and industries. These representatives analyze a school and, if found satisfactory, place it on an approved list to come before the notice of the educational committee.

A course of instruction is expected to accomplish one of the following four results with the individual.

1. Make a semi-skilled mechanic such as a drill press hand or second-class lathe operator from a novice.

2. A good technician, as for instance a chauffeur from a novice.

3. An expert in some special line of work from a skilled or semi-skilled journeyman, as, for instance, a wood specialist on airplanes from a cabinet maker or an ignition repair man from a garage mechanic.

4. A fairly skilled mechanic from a semi-skilled worker, as, for instance, a fairly good blacksmith from a blacksmith's helper. The schools are being asked to train men in the following and other lines: Airplane mechanicians, repairmen, chauffeurs, draftsmen, gas engine repairmen, ignition repairmen, motorcycle repairmen, sheet metal workers, wood workers and welders.

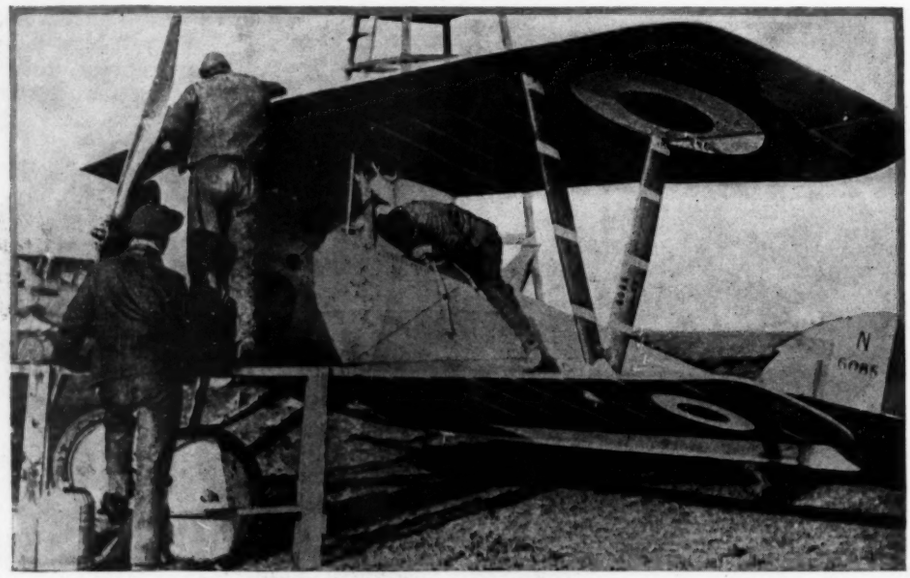
A tentative schedule has been arranged for 70,000 mechanics as follows:

Begin training with...	10,000 men	March 15
Increase to.....	20,000 men	April 1
Discharge	20,000 men	May 30
Take on.....	25,000 men	June 1
Discharge	25,000 men	July 30
Take on.....	25,000 men	August 1
Discharge	25,000 men	Sept. 30

It is planned to divide these men into eighty squadrons of 125 men to a squadron, and each squadron of future soldiers will be taught twenty-one trades in all.

ORDNANCE WANTS CATALOGS

Washington, Feb. 22—The motor equipment section of the Ordnance Department would like to receive catalogs from all the different motor car makers as well as motor car accessory makers. Such should be addressed to the Motor Equipment Section, Procurement Division, Ordnance Department, Sixth and B streets, Washington, D. C.



An aviator may take many chances while in the air fighting, but not in seeing that his plane is tested before leaving ground. Every machine is tested by expert mechanicians

U.S.A. Engineers Abroad

To Aid in Forming International Standards That Will Help Speed Up

Aircraft Board Represented in American Delegation

WASHINGTON, Feb. 23—Standardization of manufacturing materials related to production of motor cars, motor trucks, airplanes, tractors and machinery takes a new step with the announcement of the arrival in England of delegates from all the Allied countries for conference on international standards. The American delegation headed by F. G. Diffin and representing the Aircraft Production Board arrived safely late last week and includes members from all the prominent American engineering societies: The Society of Automotive Engineers, American Society of Mechanical Engineers, American Society of Testing Materials, etc. There are also members from the aircraft board, the advisory committee on aeronautics, the Signal Corps, the Navy and the original International Aircraft Standards Board from which this conference is an outgrowth. The American members are F. G. Diffin, chairman, Dr. W. F. Durand, Lieut.-Commander Benjamin Briscoe, Lieut. W. F. Prentice, E. H. Ehrman, Charles M. Manley, James Hartness, Albert L. Colby, Capt. A. B. Tilt, E. G. Ericson, C. F. Clarkson and F. R. Baxter.

Mr. Diffin has been in charge of international standardization work at Washington, and the present conference is the result of Mr. Diffin's work during the last nine months. The congress will influence future international manufacturing. No attempt will be made by the conference to standardize airplane construction but rather those materials and units which are causing difficulties in purchase and delivery.

LAMP WORKS BUY ABBOTT

Cleveland, Ohio, Feb. 22—The National Electric Lamp Works of the General Electric Co. has purchased the plant and land of the defunct Abbott corporation for a consideration understood to be about $200,000. The deal includes a one-story building, 110 by 681 ft., and 5½ acres of land. It is stated at the lamp works that the Abbott building will be used for a machinery building.

USED CAR DEMAND GROWS

St. Louis, Mo., Feb. 25—Practically every used car dealer here is in the market for cars, especially the light cars. All dealers are looking forward to an excellent season and are anxious to acquire stock.

The Ford dealers are not selling the used cars they have in stock. One dealer admits that he has thirty passenger cars on hand and that he did not sell one during the streetcar strike, when prices were advanced somewhat on light used cars. He preferred to take his chances on sales later

in the year. At present Ford dealers here are three weeks behind on deliveries of new cars.

Since a year ago there has been a notable improvement in the housing of the used car departments of the large agencies. Then the used cars were put any place and allowed to sell themselves. Within the year, several departments have been moved into good showrooms, where window displays are used and the trade given a considerable boost in tone.

KOEHLER ADDS TWO MODELS

Newark, N. J., Feb. 23—The H. J. Koehler Motors Corp. has added two models to its line, a 2½ to 3-ton truck at $1,985 and a 5-ton tractor at $2,165. General specifications apply to the new truck, except that it is more massively constructed. It is fitted with a Torbensen rear axle of larger size, larger-sized Koehler radiator, wheelbase of 151 in.; tires, 34 to 4 in front by 34 to 6 in rear; gear ratio 9 to 1; brakes 18 in. in diameter; springs 2½ in. wide in front and 3 in. in rear; frame 5 in. deep by 143 in. with a governor as standard equipment.

The 5-ton tractor embodies the specifications of the new truck with these exceptions: Minimum wheelbase of 106 in.; gear ratio 10 to 1; springs specially constructed for tractor work; rocking fifth wheel of suitable greater capacity; driver's cab complete with curtains; disappearing frame at rear and platform covering frame between fifth wheel and driver's seat.

WISCONSIN DUPLEX IS LAUNCHED

Oshkosh, Wis., Feb. 22—The Wisconsin Duplex Auto Co., organized a year ago with $500,000 capital by William A. Besserdich, one of the original members of the present Four-Wheel-Drive Automobile Co., Clintonville, Wis., has completed all details of its organization. The officers are: President, W. A. Besserdich; vice-president, H. F. Landeck; secretary, B. A. Mosling; treasurer, J. P. Mosling. The company has taken over the plant of the J. L. Clark Carriage Co. at Oshkosh and will install new machinery and equipment. It will concentrate on a 1-ton truck chassis employing a quadruple-drive transmission system designed and patented by Mr. Besserdich. Several demonstrating chassis have been constructed in a Milwaukee machine shop and one is undergoing exhaustive Government tests. Arrangements are being made with a view of having the chassis in production by March 15 or April 1.

SPLIT-NUT STEERING GEAR

Racine, Wis., Feb. 22—The Wohlrab Gear Co. of this city is just starting production and the manufacture of a split-nut steering gear for motor trucks. The gear is designed to operate with oil in the housing instead of grease, this being made possible by a patented construction of the housing and the exterior arrangement. The Wohlrab company has been incorporated under the laws of Wisconsin for $75,000 with T. B. Wohlrab as president; E. M. Caskey, vice-president; E. J. Smieding, secretary and J. G. Kluyskens, export sales manager.

Race Events Promised

Dirt Track Association Cites Washington Assurances of Transportation

Half of Drivers Registered in U. S. A. Service

CHICAGO, Feb. 23—Rumors of racing, including several ambitious programs for the coming season, have been numerous but not many of them are capable of being authenticated. As announced in MOTOR AGE last week Pickens and Wellman announce entries of six stars, including Ralph de Palma and Resta, as well as four famous European pilots, who will compete at Sheepshead Bay Memorial Day, at Providence July 4, and perhaps at Chicago and Cincinnati later. De Palma, when interviewed by a MOTOR AGE representative last Saturday, stated that he had not signed with any race promoters and would not do so unless some definite statement was forthcoming from the Government, approving racing for the coming season.

Charles Johnson, president of the Uniontown speedway and constructing the Philadelphia track and who is said to control the Des Moines speedway and to hold an option on the Minneapolis oval, formed last year a national grand circuit which for a time at least has subsided. Johnson got the contracts of some twenty-seven racing drivers for 1918.

Events on the dirt tracks are promised in large numbers by the International Motor Contest Association, which claims to have received assurances from Washington that its drivers will have no difficulty in shipping their cars and there will be no restrictions placed on gasoline for racing purposes. The I. M. C. A., which stages races at state and county fairs, has forty-two drivers registered, half of whom are in the service. Louis Disbrow is slated as of the dirt track stars and will be at the wheel of the old front-drive Christie, which he bought from Barney Oldfield last summer.

Wellman has evinced a disposition to permit the six drivers he has under contract to compete at speedway events other than his own and it may be that Chicago and Cincinnati may put on races of their own with the Wellman string of stars as headliners.

The probability has been expressed in altoritative centers that the American Speedway Association may formulate rules and govern the 1918 races. A meeting of the association is to be held by the middle of March at which definite decision will be reached on this point. The attitude of the speedway managers at the present moment seems to be one of watchful waiting without binding themselves to any promoters or program just now.

CHANDLER EARNS $2,382,403

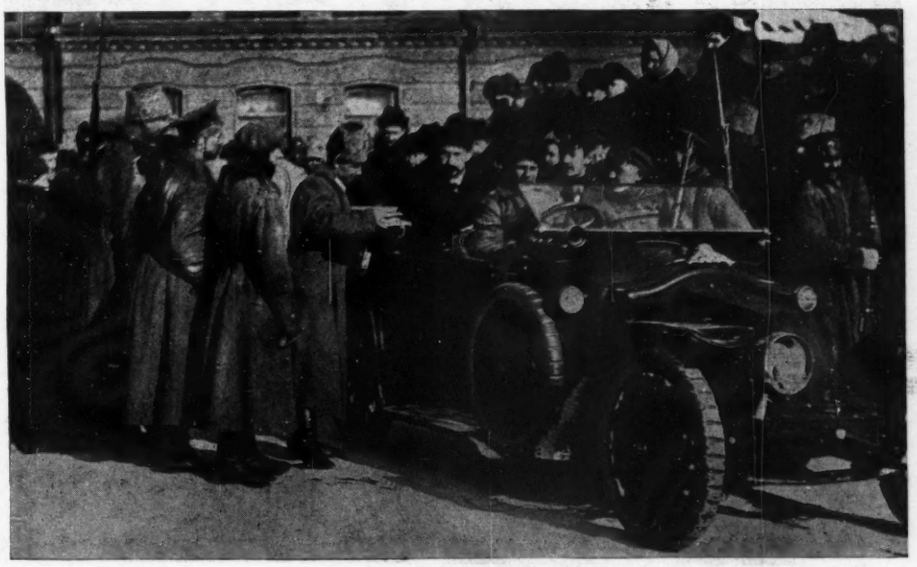
Cleveland, Ohio, Feb. 22—Net profits of the Chandler Motor Car Co. for 1917 were $2,382,403, a gain of $666,235 from 1916. The gross income was $3,277,715, which is $843,945 more than in 1916. The earnings equal $34 a share on the outstanding stock, compared with $24.50 in 1916.

DORT STEPS UP PRODUCTION

Flint, Mich., Feb. 22—The Dort Motor Car Co. and its Canadian associate, Gray-Dort Motors, Ltd., of Chatham, Ont., produced about 8000 cars in its first year. The next year the production increased practically 100 per cent, and this year it is expected that the two plants will turn out 20,000 cars.

CLEVELAND AS TRACTOR HUB

Cleveland, Ohio, Feb. 22—Work has been started on the $1,000,000 factory building for the Cleveland Tractor Co. At the same time announcement is made that the Chandler Motor Car Co. has been awarded a large contract from the Government for the manufacture of tractors. The Chandler contract will necessitate additions to the present plant which will take



This photograph, taken after the Bolsheviki gained control in Russia, shows Leon Trotsky, foreign minister, in the car, which is well guarded. Trotsky is leaving the council headquarters

several years to complete. Although the exact amount of the contract is unknown, it is estimated at $10,000,000 or more. It is understood the tractor will be of heavy-duty type and will be furnished to the allies by the United States. These two factories, that of Chandler and the Cleveland tractor, will make Cleveland a tractor center. The Cleveland tractor plant will be on a 60-acre tract, and the first section is to be concrete, 180 by 440. This is to be a fourth of the completed factory, and it is to be devoted entirely to the caterpillar type tractor built by the Cleveland concern.

The J. T. Tractor Co. is expected to acquire a plant soon for manufacturing its product, also a caterpillar type. The J. T. company is headed by George P. Comey, president; J. J. Tracy, chief engineer, and Harry L. Lance, general manager.

NELSON TO ADD TO LINE

Saginaw, Mich., Feb. 12—Nelson Brothers Co. of this city has formed a separate organization known as the Nelson Motor Truck Co. and has begun the manufacture of a 2½-ton internal gear-driven truck. It is the intention of the concern to add other sizes to the line as rapidly as possible. The new vehicle is known as the Jumbo.

ICE MISHAP HITS CHEVROLET

Flint, Mich., Feb. 22—The plant of the Chevrolet Motor Co. had to shut down for 24 hr. this week due to the fact that the gas main leading to the plant was carried away by slipping ice which broke a bridge over which the main passed.

GEORGE K. BIRGE DIES

Buffalo, N. Y., Feb. 23—George K. Birge, reorganizer of the Pierce-Arrow Co. and its president for many years, is dead. In 1896 Mr. Birge reorganized the George N. Pierce Co., then manufacturing bicycles.

Huge Tractor Show Sales

Total at Kansas City Exhibition Placed at $3,000,000—One Dealer Takes 400

To Hold Fourth Annual Next February

KANSAS CITY, Mo., Feb. 23—The sale of tractors at the third annual tractor show held here Feb. 11-16 aggregated $3,000,000 for the six days. One California buyer purchased 400 tractors and 250 gang plows. Another California dealer bought 225 tractors and spent thousands of dollars for accessories. So pleased are the exhibitors with the results that they have voted unanimously to hold the fourth annual tractor show in Kansas City, Feb. 10-16, 1919.

Farmers from practically every section of the country attended this year's show. The owner of a big Mexican ranch came all the way from his country in spite of the disturbed conditions of travel in Mexico. This man bought tractors and tractor accessories for his land in Chihuahua.

The show was held under the auspices of the Kansas City Tractor Club. The special building covered 75,000 sq. ft. of floor space and cost more than $25,000. This will not be available next year.

Less than 10 hr. after the last of the exhibits of the third annual tractor show had been removed from the exhibit building on Union Station Plaza here fire completely destroyed the building. When carpenters entered this morning to begin to dismantle it to ship the material to Camp Funston near Fort Riley, Kan., to be converted into a soldiers' clubhouse the building was found to be on fire, supposedly from a cigarette thrown into waste material from the decorations of last week.

The building, which was erected for the tractor show, was insured for $10,000. Several oil-burning furnaces used to heat the building were the only loss, except the material in the structure. It was 130 ft. wide and 460 ft. long and was constructed entirely of wooden materials covered with tarred paper. The front third of the building was to have been retained as it stood for a soldiers' clubhouse on account of its proximity to the new $15,000,000 Kansas City Union Station.

Canada Lifts Tractor Duty

Vancouver, B. C., Feb. 23—Farmers of Manitoba, Saskatchewan and Alberta are highly elated over the recent Canadian order which places tractors costing less than $1,400 on the free list. The removal of 20 per cent of the initial cost of tractors will more than offset the increased cost of kerosene.

Last September the greatly increased acreage of fall plowing indicated that the 1918 wheat acreage of western Canada would surpass by 10 or 15 per cent the highest record of former years. The heavy snowfall has been sufficient to insure at least an average crop with proper farming. In addition the average price of horses has jumped from $135 to $176 since the beginning of the war. There has been a decided tendency for farmers of moderate farms to reduce the number of horses and use tractors. Thousands will be sold within the next few months for spring and summer plowing.

Two methods of farming are followed in western Canada, wheat mining by large syndicates who cultivate ten or twelve sections and farming by those who filed on homesteads six or ten years ago and who now cultivate half or three-quarters of a section.

At Camp Dix the tank Britannia performed many feats for the National Army men, going through the forest and through the side of a building as tanks do in actual warfare

TRACTOR TRADE ORGANIZATION

Minneapolis, Minn., Feb. 22—The Northwest Tractor Trade Association was formed with thirty-six members at a meeting attended by eighty persons. Dues were put at $50 a year, payable semi-annually, and the organization started after adoption of by-laws with officers as follows: President, D. J. Murphy; vice-presidents, N. B. Nelson and J. M. Orton; secretary, W. B. Gleeson; and treasurer, P. J. Perry.

The purpose of the organization is to bring the manufacturers and distributors of tractors and power machinery into cooperation for furthering of the industry. Membership is open to all manufacturers of gas, oil and steam tractors and plows and accessories, distributors and factory branch managers. The only paid official will be an assistant secretary.

FRANKLIN GAINS 135 PER CENT

Syracuse, N. Y., Feb. 22.—The output of the Franklin Automobile Co. during 1917 advanced 135 per cent, or from 3800 in 1916 to 9000. The business reached a total of $16,000,000 for the year.

MADISON SHOW IS AUTOMOTIVE

Madison, Wis., Feb. 23—The sixth annual motor show conducted by dealers and distributors of Madison, Wis., Feb. 20-22, proved to be one of the most comprehensive displays of the kind ever made in Wisconsin and may be characterized as a mini-

ature of the 1918 Minneapolis show because it devoted exceptional attention to trucks, tractors, etc., rather than concentrating on passenger cars. The show covered about 45,000 sq. ft. The decorative scheme used by the Milwaukee Automobile Dealers, Inc., at Milwaukee, Jan. 17-26 was used. A feature of the display was a section devoted to photographic illustrations of passenger cars, motor trucks, tractors, tanks, etc., in actual service on the French battlefront. The attendance is estimated at more than 50,000 for the three days.

THIRTY HARROUN CARS DAILY

Wayne, Mich., Feb. 22—The production of the Harroun Motors Corp. is now up to thirty per day. This production is being maintained in spite of the fact that a large contract calling for several million 155 mm. shells has been taken by the company. It is probable also assembly work on the class AA truck also will be undertaken at the Harroun plant, but this also will not interfere with the production which is expected to increase rather than decrease. To date the company has not had to complain of freight car facilities owing to its location outside the congested belt area.

SAXON FLOOR SPACE DRAFTED

Detroit, Feb. 22—The Michigan avenue plant of the Saxon Motor Car Corp. has been taken over by the Government for munition storage. The transaction was made through the Industrial Terminal Corp., which is a bonding company, and the records filed Monday in the office of the Registrar of deeds show that the consideration was for $800,000. This plant is the new building which was erected by the Saxon company and which was to house the entire business. It has been used in part for storage purposes by the Saxon company but has not been completed to a sufficient extent for manufacturing purposes. The deed to the property was signed by Benjamin Godfredson, president of the Saxon company, and C. A. Pfeffer, secretary. Besides the building, a large piece of land lying between two adjacent roads has been secured and is involved in the transfer.

WANTED: A NEW NAME

Washington, Feb. 23—The Navy Department has asked the public to suggest a name for the new submarine chasers being built by Henry Ford. Two letters are wanted. Assistant Secretary Roosevelt proposed S. D. for submarine destroyers but he thinks a better name can be found. J. M. (jitney marines), T. J. (tin jennies) and other like suggestions have been made but not approved. The Ford ships are going to be midway between submarine chasers and destroyers. They will use depth bombs as their principal weapons.

1918 ELGIN SPECIFICATIONS

Chicago, Feb. 23—Through a misunderstanding the specifications given out by the Elgin Motor Car Corp. on its 1918 models showed the bore and stroke as 3⅛ by 4¼ and the tires as 32 by 4. The regular size tires furnished on the standard model are 33 by 4 and the bore and stroke is 3 by 4¼.

Eastbound Drives Begin

Chicago Launches Thirty Motor Trucks on Journey Overland to Pittsburgh

Receives and Ships Motor Cars Under Own Power

CHICAGO, Feb. 25—Chicago's first driveaway to an eastern point commences tomorrow when thirty Master trucks leave over the Lincoln highway for Pittsburgh, Pa. It is expected that eighteen more trucks will leave for the same destination in two weeks.

Among the local dealers the driveways to Chicago are progressing very well and the Buick branch expects 130 cars from Flint tonight. This company is receiving on the average about 100 cars per day and expects to better this figure within the next ten days. The recent warm weather has not affected the roads, which still remain solid and in good shape for rapid traveling. The local Overland branch is driving about twenty cars per day through from Toledo and is planning on exceeding this figure soon. This company is using Chicago as a distributing center for points west, the cars being driven in from the factory and then shipped west by railroad.

The local Dodge Brothers' distributors have three crews bringing the driveaways from Detroit and are averaging about forty-five cars per week. Each of the crews is handling about fifteen cars per trip. The northern route is being used, as it is considerably shorter than the other, and as the roads have been found to be in good condition it means a considerable saving of time.

Reo has chartered two express cars, and these are making round trips between Lansing and Chicago, hauling ten cars per trip. The vehicles are shipped knocked down, as by these means five cars can be loaded in one express car.

Many dealers in the Middle West have ceased to rely upon the railroads and have adopted the driveaway method. Many of the convoys seen recently have been bound for points in Iowa and Nebraska.

War Order Holders

WASHINGTON, Feb. 23—The action of Secretary of War Baker in permitting military contracts to be made known is accompanied by the publication of the following lists of companies which are working on Government passenger car, truck and motorcycle requirements. The list is issued by H. L. Horning, chairman of the automotive products section of the Council of National Defense and represents only those contracts which have come through Mr. Horning's office for approval. No publicity is given to tractor contracts, which includes tanks, or to the amount or sizes of contracts.

Making Trucks

Denby Motor Truck Co.....Detroit
Dodge Brothers.....Detroit
Packard Motor Co.....Detroit
Hudson Motor Car Co.....Detroit
Four Wheel Drive Auto Co....Clintonville, Wis.
Garford Motor Truck Co.....Lima, Ohio
International Motor Truck Co.....New York
Kelly-Springfield Motor Truck Co.....Springfield, Ohio
Locomobile Co.....Bridgeport, Conn.
Pierce-Arrow Motor Co.....Buffalo, N. Y.
Standard Motor Truck Co.....Detroit
United States Motor Truck Co..Cincinnati, Ohio
Velie Motors Corp.....Moline, Ill.
Bethlehem Motors Corp.....Allentown, Pa.
Brockway Motor Truck Co.....Cortland, N. Y.
Diamond T Motor Car Co.....Chicago
Gramm-Bernstein Motor Truck Co...Lima, Ohio
Indiana Truck Corp.....Marion, Ind.
Selden Motor Truck Co.....Rochester, N. Y.
Service Motor Truck Co.....Wabash, Ind.
National Motor Car & Vehicle Corp.....Indianapolis, Ind.
Premier Motor Corp.....Indianapolis, Ind.
Federal Motor Truck Co.....Detroit
Paige-Detroit Motor Corp.....Detroit
Commerce Motor Car Co.....Detroit
General Motors Co.....Pontiac, Mich.
Nash Motors Co.....Kenosha, Wis.
Republic Motor Truck Co.....Alma, Mich.
United Motors Co.....Grand Rapids, Mich.
White Co.....Cleveland, Ohio
Sterling Motor Truck Co.....Milwaukee, Wis.
Mitchell Motor Co.....Racine, Wis.
Kissel Motor Co.....Hartford, Wis.

Making Passenger Cars

Cadillac Motor Co.....Detroit
Dodge Brothers.....Detroit

Making Motorcycles

Harley-Davidson Motorcycle Co.....Milwaukee, Wis.
Hendee Mfg. Co.....Springfield, Mass.

PICTURES OF ALL EMPLOYEES

Detroit, Feb. 25—In accordance with the request of the Government the heads of all industrial establishments together with their employees must be photographed and listed for identification. The work has just been completed at the Ford factory where every one from Henry Ford down was photographed by the official photographer. Five photographs, it is understood, are to be made of each man. Each man is to be known by a number and when photographed he must carry his number on his chest. Two of the photographs are to be retained by the employer, one by the Government, one by the police and the other serves as an identification card for the man.

CHANGES IN KING PERSONNEL

Detroit, Feb. 23—J. B. Siegfried has been appointed general manager of the King Motor Car Co. He has been an executive of the company for several years, first as production manager and later as assistant general manager.

William Burgess Nesbitt, who for five years has been advertising manager of King, has been elected vice-president of the company, to succeeded T. E. A. Barthel. His headquarters will be in New York.

TOM THUMB MAKER ELECTS

Minneapolis, Minn., Feb. 23—H. A. Brown has been elected president of the Federal Tractor Co., maker of the Tom Thumb; J. N. Kirby, vice-president; and A. A. Robbins, secretary-treasurer. As Mr. Brown has been commissioned a major and is in Washington to assist in tractor and artillery production, Mr. Robbins will have active control.

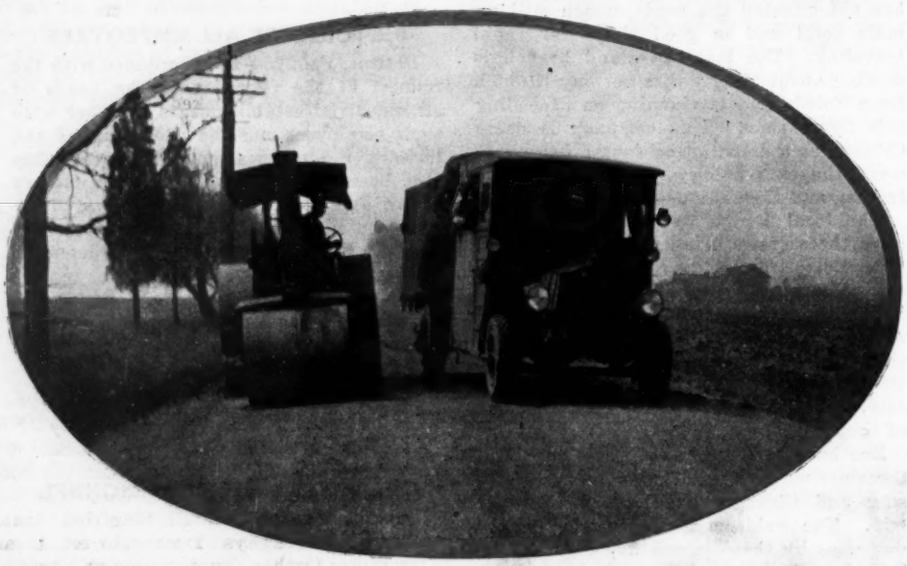
PATHFINDER ASSETS AUCTION

Chicago, Feb. 22—The entire stock, machinery and equipment and finished cars of the Pathfinder Motor Co. of America, Indianapolis, Ind., will be sold at auction March 5 at Indianapolis by Samuel L. Winternitz & Co., Chicago, auctioneers. The property inventories at over $500,000.

Akron to Boston by Truck

Regular Schedule Over 740-Mile Route

The loaded truck reaches the end of the improved road between New Springfield, Ohio, and Beaver Falls, Pa.



Such road maintenance as this on the Lincoln highway near Lancaster, Pa., makes possible operation of trucks on regular schedule

The 3½-ton Mack pulling through a great drift this side of the Alleghennies after shovelers had helped clear the road cut through

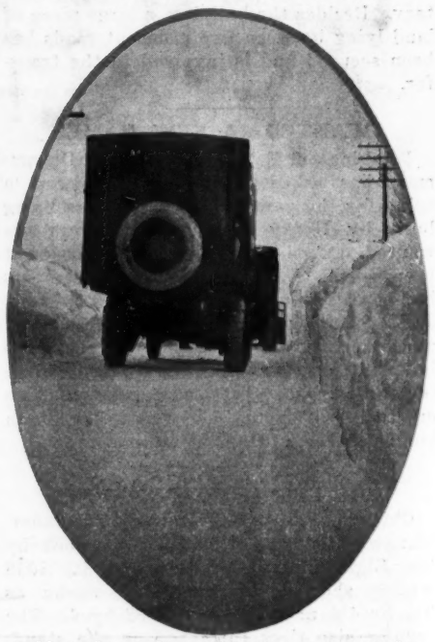
THE driveaways of the Government war trucks, ccupled with the need arising out of the continued freight congestion, have brought about a development of motor truck haulage inconceivable to many even now. While this development is largely a result of unusual congestion in abnormal war conditions, the trucks in use already have demonstrated a saving of time that will bring further development of overland haulage by motor trucks whether the congestion continues or not.

Began Operating Last April

The route established by the Goodyear Tire & Rubber Co. is one of the most prominent in overland trucking. The company began to operate its first truck between Akron and Boston April 9, 1917. It now has seven running on a regular schedule over the 740-mile route. The idea started in tire testing with the carrying of goods a secondary matter, necessary primarily to test out the giant pneumatics under the same conditions as in actual service. The first truck was a 5-ton Packard, and it made the trip in seventeen days. Now the same truck and others of the fleet are making the same run in four days, and in several instances a complete round trip of 1480 miles has been made in six and a half days. A 3½-ton Mack, a late addition to the fleet, made the trip between New York and Akron, 533 miles, in 60 hr. total time and 49 hr. actual running time.

The Goodyear company has added six others to the original truck, two 5-ton Whites, a 3-ton White, a 3-ton Packard, a 1½-ton White and the 3½-ton Mack. The latest truck to go into service is a 3-ton Packard having the engine usually fitted on the 5-ton.

The giant pneumatics have played a large part in the successful operation of



Note how the spare tire is carried on the tailgate of the truck

the trucks in that more speed is possible with pneumatics than with solids. More speed means a saving in time, which is so important in transportation. The cost per ton delivered is going to be of the greatest importance in overland haulage by motor trucks, and the pneumatic tire seems destined to be one of the main factors in reducing the cost because of the increased speeds and the less repairs through the cushioning for the truck mechanism. Ten months of operation by Goodyear have demonstrated need of improvement not only in the tires undergoing experiment but in the trucks themselves. At first there was much tire trouble. The beading was too weak for the loads. Many of the tires were removed before entirely worn and cut apart to see what effect wear had had. Tire sizes and inflation pressures, side wall thicknesses and other points of construction were worked out as a result of the first trips early last spring. The tires now in use are giving satisfaction, though experiments are being made with tires of even larger size, 48 by 12 on the 5-tonners.

The steep ascents and long pulls in the Pennsylvania mountains have shown that the engines must be more rugged than those in average use. The connecting rods gave particular trouble. In one or two cases they twisted off and smashed the crankcases when they let go. The engine of the initial truck had this trouble until it was fitted with a new engine that had heavier connecting rods, since which the truck has been in continuous service without trouble. The last 3-ton addition to the fleet has an engine of a size usually fitted to a 5-ton truck to get more power and more speed.

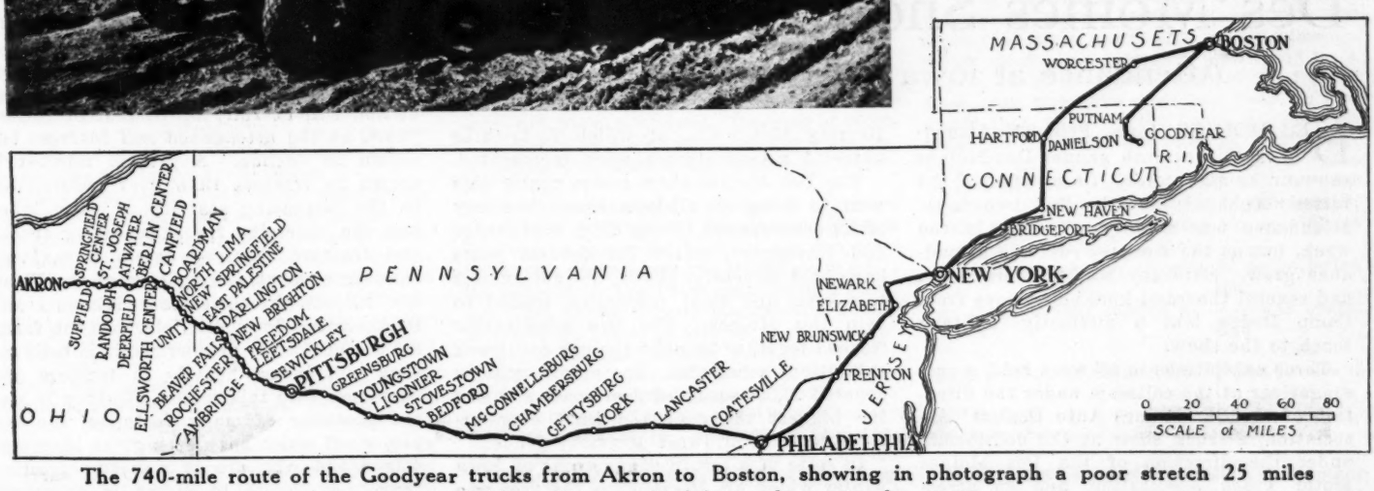
The question of the most economical size of load has not been settled yet. The trucks are running on a 24-hr. schedule, one driver sleeping while the other drives. The sleeping compartment runs crosswise of the truck body directly back of the driver's seat and is entered through a sliding door in a partition that extends to the roof of the truck. The compartment is well ventilated and fitted with regulation single bedspring and mattress. As the drivers have to stay with the truck continually and valuable loads are carried, Goodyear employs only the best drivers obtainable and pays them $175 a month. Out of this they buy their own meals unless they have to put up at some hotel on account of repairs, when hotel bills and meals are paid by Goodyear.

College students, real laborers, and even young boys are pressed into service to keep the Pennsylvania route open for Army trucks

Loads Carried by Trucks

The trucks carry finished tires from the Akron factory to the Boston branch and other branches enroute and then run from Boston to Goodyear, Conn., where a load of tire fabric is picked up for the return trip. The drivers do not stay over at the eastern end of the trip but begin the return runs immediately. On arrival at Akron each driver is given two days off before the next trip is begun.

The route was selected after much consideration. More mileage than necessary is covered because of weak bridges on the other route available. This emphasizes again what MOTOR AGE has been advocating, that suitable motor truck roads must be provided for the utilization of all means of transportation now that war exigencies make them so necessary. Difficulty of operating through the deep snows was overcome to a great extent in that the route followed by the Goodyear fleet is in part the same as that used by the Government truck driveaways from Cleveland and points farther west, except between Youngstown, Warren and Ravenna, Ohio, followed by the war trucks and the Goodyear southern route through Southern Ohio, Pennsylvania and New Jersey. From Beaver Falls east to New York the route is over the Lincoln. The steepest of the



The 740-mile route of the Goodyear trucks from Akron to Boston, showing in photograph a poor stretch 25 miles east of Akron later avoided by a change in the route

The 3-ton White with giant non-skid chains on the rear tires, ordinary cab and extra tool box and tank on running board

This drift is as deep as the truck is high, though snow-removal work eliminates serious delays of the truck expresses

route crosses the Allegheny mountains. It was at these points that the greatest difficulty was expected, but this was avoided through the splendid manner in which Pennsylvania kept the route open as a war measure to aid in the delivery of Government war trucks.

The Goodyear trucks carry full loads both ways and this will have to be the case in future overland truck haulage to keep the cost from being prohibitive. In the case of Goodyear the company could arrange its haulage so that return loads are always available. This will have to be solved in other cases by co-operation between cities or business, such as outlined as the return loads system, which Connecticut has put into operation.

Des Moines Show Sets Record

Attendance at Iowa Indicates Optimism

DES MOINES, Iowa, Feb. 23—Attendance at the ninth annual Des Moines show broke all records. On account of the bitterly cold weather the first two days' attendance was slightly off early in the week, but as the mercury rose the attendance grew. Saturday was Soldiers' Day, and several thousand khaki-clad boys from Camp Dodge lent a distinctly military touch to the show.

Three exhibitions in all were held, a passenger car at the coliseum under the direction of the Des Moines Auto Dealers' Association, a truck show at the auditorium under the direction of the Des Moines Motor Truck Association, and an accessory show in the service building of the Herring Motor Co., at which forty-three national manufacturers were represented.

The Des Moines show comes nearer this year to being an all-Iowa show than any of its predecessors. Sioux City, Fort Dodge and Davenport, which for several years have held successful shows, did not exhibit this year, and their suspension tended to help Des Moines. The two associations worked together to make the car and truck exhibitions successful. The accessory show covered 20,000 sq. ft. of floor space and was the biggest thing of the kind ever attempted by a Midwest accessory jobber.

In spite of a return engagement of Iowa winter which hit Des Moines the first two days, the cheery, springlike decorations had such a good influence over exhibitors, dealers and visitors that optimism was the keynote of the shows. That motor car sales in the Iowa territory will break all records this summer and fall, if sufficient deliveries can be obtained, is the unanimous decision of the 1200 dealers who came from out of town.

Iowa is enjoying the greatest prosperity it has ever known. Last fall crops were record breakers and they are bringing the highest prices ever commanded. In spite of Liberty Loan campaigns, war work and conservation the people of the state have the most money on deposit in banks in the history of the state. The state derives practically all its wealth from agriculture and with bumper crops bringing record prices the present prosperity is assured for a long time.

That these statements are not overdrawn is shown by the fact that up to Feb. 15 there had been registered with the secretary of state's office 53,850 cars as against 49,600 for the same period last year.

Neither the big show nor the motor truck show offered tractors this year simply because there was no room to show them. All during the week, however, there was a very noticeable interest shown by inquiry about tractors. In fact the demand was so strong that officials of the show already are making plans to have a big tractor exhibit in 1919. The possibility of constructing a building on the river front adjoining the coliseum to house the tractor display is being considered by officers and directors of the Des Moines Auto Dealers' Association.

At the motor truck show increased interest was shown by buyers. The truck show was strictly a business show and a large part of the visitors were prospective buyers who really were interested. The last year has been by long odds the best the commercial car dealers in Des Moines have ever had.

SEVENTY-FIVE QUINCY EXHIBITS

Quincy, Ill., Feb. 23—The tenth annual motor car show of the Quincy dealers opened Wednesday and closes Saturday. All of the seventy-one spaces in the Armory are taken. The decorations are red, white, and blue. Thursday was designated as "Good Roads Day" and talks were given in the interest of hard roads. There are five exhibits of trucks and tractors.

The dealers here believe that the net value of the show as an advertising proposition will be fully up to that of former years, as the attendance and interest has shown no decline. A greater interest is shown in tractors than ever before, due to the increasing scarcity of farm labor and the necessity for substituting trucks and tractors. Quincy caters to a large farming element, taking care of the Western Illinois, Northweastern Missouri and Southeastern Iowa districts. As the farmers are uniformly prosperous, it is believed they will invest heavily in tractors and passenger cars this season. Quincy is also the possessor of many factories, the employees of which have been given increased wages and who are in a better position than ever before to invest in passenger cars.

Care in Selecting Tractors

Relation to Number of Cultivated Acres on Farm of Moment—Difference from Motor Car

CHICAGO, Feb. 22—Selection of tractors in accordance with the number of cultivated acres to be economical on a farm, the relation of the S. A. E. to the automotive industry and the fundamental differences between the tractor and the motor car were the subjects discussed at the meeting of the Mid-West section of the Society of Automotive Engineers last night.

David Beecroft, first vice-president of the S. A. E. and directing editor of the Class Journal Co., spoke of the enlarged activities of the society and its extension to take in the motor truck, airplane, tractor, motorcycle, motor boat and stationary engine industries in addition to the motor car, which formed the basis for the origin of the society. He also spoke of the importance of the tractor with regard to increased food production and of the close relation existing between the society and the Government in furthering the latter's war plans.

How Tractor Differs

Dent Parrett of the Parrett Tractor Co. spoke on the fundamental differences existing between the motor car and the tractor from the viewpoint of design and manufacture. He compared the differences between the various principle units, the reasons for this difference and their adaptation to the tractor. Mr. Parrett said in part:

"From my own experience, I find there is often times a tendency to compare the tractor with the motor car or truck. In many ways they are similar; in many ways they are not. In the first place the purpose of the motor car and truck is entirely different than that of the tractor. The truck or motor car carries a load within itself and it travels most of the time at least over pavements or fairly hard roads. The tractor on the contrary pulls its load at slow speed; it has to travel over fields of plowed ground and often the ground is rough and the tractor must cross the rough ground and even ditches and bad places which would be impassable for a motor car or truck.

"The development of the power and the method of transmitting the power are the same. The engine compares more closely; the transmission of power is very similar, except that, although same in principle, it must have a greater gear reduction.

"On top of the fact that the tractor pulls its load instead of carrying it, the type of wheel is, of course, very different from that used on motor cars or trucks; it is necessary that these wheels have some sort of lug, which gives the tractor its necessary traction to pull its load."

The Economic Sizes of Tractors

By Ernest Goldberger

Efficiency Engineer Packard Motor Car Co.

A COUPLE of years ago a study of the cost of plowing with tractors would not have been of any practical value, since the conclusions, even though they might have been drawn in the most logical way, would have been based upon theoretical assumptions, and hence the conclusions, too, would have been theoretical.

During the last few years the line of tractors has been extended, till now we have on the market practically any size of tractor ranging from 10 up to 120 hp., and from their performance and prices and being acquainted with the requirements on the farm and the manufacturing problems, it is possible not only to draw correct conclusions referring to the present conditions but also what from a business standpoint is more important, to anticipate the future development.

Many students of this problem undoubtedly will say conditions on the farms are so different as to the quality of soil, size of farm, kind of crop and hundreds of other things, that considering everything that enters into the problem, a general and intelligent solution of it is precluded, while without taking everything into consideration the solution cannot be correct.

One way of attacking the problem is by national referendum, that is, having every tractor owner state the size of tractor and farm he has got, perhaps also the size he thinks would suit him better and draw the conclusion according to the law of averages. The Department of Agriculture has published in book form the results of such an investigation directed by A. P. Yerkes, and it is of interest to note that although following different methods, the results of the survey agree with the conclusions which follow the thought of this study.

I shall consider in the following three sizes of tractor that would be built along exactly the same standards of quality, design and workmanship:

A—Capable of pulling two 14-in. plows, 6 in. deep, in average soil, at a speed of 2½ m.p.h. This would require about 9 hp. on the drawbar.

B—Same quality tractor, of double size, pulling four 14-in. plows, 6 in. deep in the same soil, 2½ m.p.h. speed. Drawbar of 18 hp.

C—Twice as strong as B, pulling eight 14-in. plows, 6 in. deep in the same soil. Drawbar 36 hp.

Since there is today no doubt in the mind of anybody familiar with the tractor problems that really successful tractors are and have to be built according to the standards of quality adopted by the truck manufacturers and not those of the country blacksmiths, I shall estimate the prices as follows:

Tractor A, $600; Tractor B, $1,500; Tractor C, $3,600. The price for tractor A, if the design, material and workmanship be first class, cannot be reached unless quantity-production methods are adopted. For 100 per cent increase in size, the price increases 150 per cent in the above estimates, since I make the preliminary assumption that with the size of the tractor increasing, the demand might decrease and the manufacturing methods to be adopted become more expensive. I shall not consider the cost of plows and other equipment, since for a comparative study of the cost of plowing with different sizes of tractors, it matters very little.

A two and a four-bottom tractor and plow can be operated easily by one man, while for an eight-bottom tractor two men are necessary, not for lifting and lowering the bottoms, which can be done automatically, but for cleaning and unclogging the plows, which would mean stopping the machine often if it were expected to be done by the man steering the tractors.

The expense for operator, therefore, would come to 30 cents per hour for the two and four-plow outfit and 60 cents for the eight-plow outfit.

Experience has shown that the fuel consumption of gasoline tractors per horsepower hour changes little or nothing with the size of motor, provided all are built according to the same standards and are run at the same percentage of load. In our case the cost for fuel, oil, etc., should be for tractor A, 25 cents per hour; tractor B, 50 cents per hour, and tractor C, $1 per hour.

Life of Tractor

One often hears the statement that a tractor will last five or six years. Such a statement is fundamentally wrong. There are two reasons why a tractor, or any machine in general, depreciates; first, the wear and tear of the machine, a factor which is altogether independent of the age of the machine, the only thing affecting it being the actual working hours; and, second, the obsolescence which on the contrary depends upon the age of the machine and not upon the working hours. The last factor is more important than the first in motor cars or any products subject to change of style, but, with utility products, it has little importance, unless a new invention changes fundamentally the existing conditions. Therefore, it is appropriate to base the allowance for deprecation upon the total actual working hours of a tractor, provided it be of progressive design, and not upon total life.

This should apply satisfactorily to horses or any draft animals whose average life is nearly constant whether they work or not. It is a conservative estimate to say that tractors of modern design of any size will depreciate after about 4500 hr. of plowing, which would give a tractor, plowing 10 hr. a day, a life of five years. Should the tractor plow only forty-five days per year its life would then figure at ten years, provided no other work is done but plowing. This estimate is safe, since 90 per cent of its value already has been figured in the item for wear and tear and part of the remaining 20 per cent easily can be recovered from the sale of its high-grade material as junk.

For tractor A the amount of depreciation per plowing-hour figures at $\frac{600}{4500} = 13$ cents; tractor B at plowing-hour figures $\frac{1500}{4500} = 33$ cents; for tractor C at $\frac{3600}{4500} = 80$ cents.

Repair and interest are considered together and estimated at 6 per cent per year on the in-

itial price of the tractor. Since the value of the tractor depreciates constantly, the interest on this value also decreases. Suppose the tractor is figured to depreciate in six years, the interest during the first year would be 6 per cent on the price paid; the following year it would be 6 per cent on the present value of the tractor, or 5 per cent of the total initial price; and so on. The allowance for interest and repairs being 6 per cent per year on the total initial price, it results that no repair allowance is made for the first year, 1 per cent of total initial value for the second, 2 per cent for the third and so on, an estimate which corresponds with the actual conditions as they occur with tractors of modern design.

Comparison of Plowing

Suppose we figure every one of these items for the tractors chosen for a variable number of actual plowing hours per year. Graph 1 is drawn based upon these figures, making on the horizontal co-ordinate the number of actual plowing hours per year, 200, 400, 600, etc., the vertical co-ordinate, the cost of plowing per hour. The curves marked A, B and C correspond to the machines above mentioned.

Graph 1 does not give a final indication as to the comparative cost of plowing with the different sizes of tractors but is used for making graphs 2 and 3. Graph 2 gives the cost in dollars per acre, varying with the number of hours plowing. Tractors A, B and C are supposed to pull 2, 4 and 8 bottoms, 14 in. wide, 6 in. deep at a speed of 2.5 m.p.h. It is assumed that the tractors will plow only 85 per cent of the time they are in the field, 15 per cent being the allowance for turning the headlands, oiling, trouble, etc. The area actually plowed per hour figures then at 6, 1.2 or 2.4 acres per hour, respectively. The small figures along the curves give the number of acres per year the chosen tractor would actually plow.

From graph 2, as a basis, graph 3 has been drawn, and this gives the final information. We read the area to be plowed in a year on the horizontal co-ordinate, follow the vertical through this point, until it intersects with the curve representing the A, B or C tractor and, following to the left, we read on the vertical co-ordinate the cost of plowing per acre. The figures along the curves give the number of hours the tractor will have to work in order to perform the work expected. Recalling now that A, B and C represent these plow tractors plowing 8 in. deep, let us now consider the significance of graph 3.

If we have to plow less than 250 acres per year and not deeper than 6 in., the tractor with 9 db-hp. plows the cheapest, while for anything above this amount, the four-plow tractor with about 18 db-hp. is the cheapest in the end, while even for farms so large that one four-plow is too small, it pays better to have two four-plow tractors than one eight-plow tractor. The advantage of having two smaller powerplant units instead of one large one forms the point of flexibility and in emergency cases is not considered at all in the charts.

Cost of Plowing

The chart shows much more than this. It shows how much cheaper the plowing costs if there be much of it to be done, or in other words, how expensive it is to be poor. There are, however, two ways that will make the small farmer meet the competition of the big one, without having to buy his neighbor's land: by deeper plowing and by plowing early and quick. To meet both of these conditions, the two-plow tractor will give way to the larger one, in fact, we find the upper curves that represent the cost of plowing 8 in. deep, that for any land above 180 acres of plowing per year, the four-plow tractor is the cheapest. While for 240 acres of plowing per year, the four-plow tractor figures only a little cheaper in dollars and cents, it has the advantage that it performs the work in about thirty days instead of sixty, as is necessary with the smaller one.

There are two ways of making a tractor intended to pull four bottoms 6 in. deep, plow 8 in. deep, first, by hitching three plow bottoms instead of four; second, by leaving the four on and plowing at the lower speed of about 1.9 m.p.h. instead of 2.5 m.p.h. There is a great advantage by applying the first method, since we cannot count on using the full power of the tractor continually where its efficiency is highest. Hard spots on the land, or grades, will be overcome by shifting to the low-speed gear. On the other hand, with a two-plow tractor, intended for 6 in. deep plowing, we have no other choice, if extra expense for specially narrow bottoms should be avoided, but to run the plows 8 in. deep on low speed all the time.

It is important to note that the conclusion has been reached, although the preliminary assumption was made that the two-plow tractor will probably be the most popular type, and therefore the cheapest to manufacture. But since we have reached the conclusion that the four-plow outfit is the most economical it cannot be expected that due to its production in large quantities its price per horsepower will not be 25 per cent higher than that of the two-plow outfit as assumed at the start of this analysis, but perhaps even lower.

In discussing Mr. Goldberg's paper Mr. Parrett made the point that while the curves may show what the two-plow outfit can do in a day on a 250-acre farm, the logical time for plowing is over a very short period of the year, and while the work from the standpoint of the mechanical efficiency might be shown in that time, from a practical standpoint the farmer could not do it in that much time. Plowing is only one of the small parts the tractor does.

Mr. Goldberger replied that he mentained that while the smaller size tractor will do the work it will not do the work quickly enough and will not plow deeply enough, and the only way the farmer can meet competition is by doing the work more quickly and plowing deeper.

"The two-plow tractor has no reason for existence," said Mr. Goldberger. "The farmer may have to pay a little more for the four-plow tractor but in the end it will be cheaper, much cheaper than the two-plow. In fact, I believe the Ford tractor is too small for modern conditions. The Ford tractor has been included in making this analysis, and my conclusion is it is too small.

"Suppose we have a 1200-acre farm, then the eight-plow tractor will plow fifty days and at $1.18. Now we find two four-plow tractors will plow on an average of

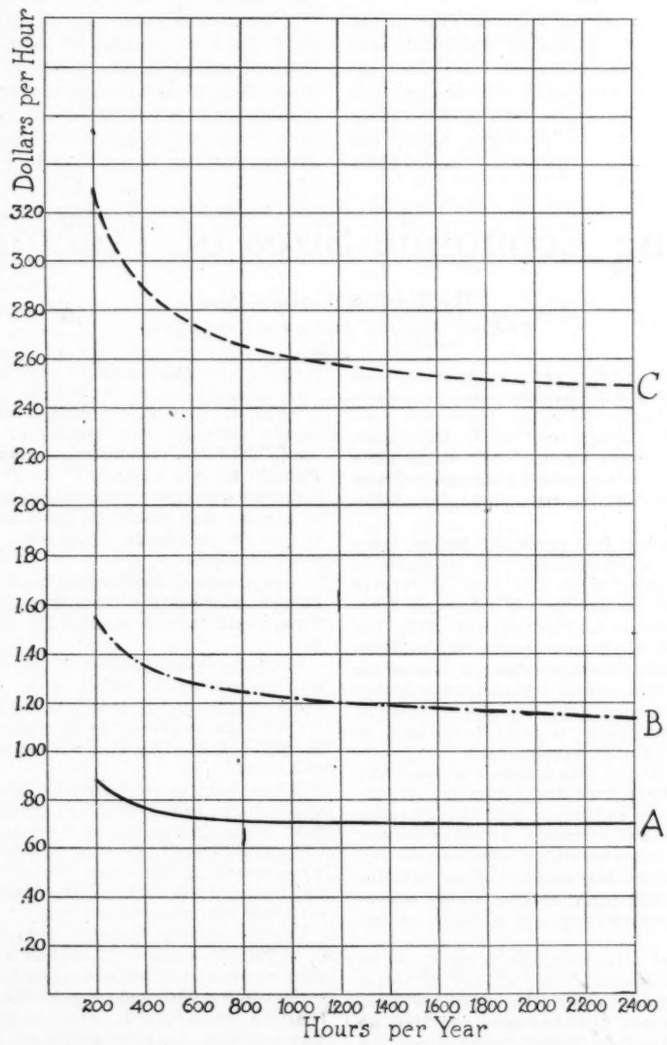


Fig. 1—Approximate cost of plowing per hour for three sizes of tractors, A, two-plow; B, four-plow, and, C, eight-plow

1200 acres, or 600 acres each, and the work will be done at $1.10 per acre instead of $1.18, so that it pays to have two four-plow tractors in competition with one eight-plow tractor.

"What I have compared is what size is more economical and whether I have two four-plow tractors or one eight-plow tractor, both of them will do the work in the same amount of time. There is a great advantage in having two small tractors instead of one big one, because suppose one small part breaks in the middle of the season. With only one tractor the farmer has to send to the factory for parts which means a delay of four or five days, but if he has two tractors he can use the tractor and a mechanic might overhaul it during the night, and he could have it to use during the day and thus keep his schedule. He could at least make 70 per cent of his schedule without any difficulty whatsoever, while if he has only one tractor and one broken he cannot make anything. The curves do not show this but it cannot be denied."

Automotive Design and Transportation

By J. Edward Schipper

Paper Before Detroit Section, S. A. E.

WE are face-to-face with a condition in automotive engineering that under ordinary circumstances would be three years or more removed. War, which throws a searchlight upon the conduct of the affairs of the nation and the individual, submits engineering practice which has to do with transportation to the more intensified beams of the X-ray. War demands a speeding up of movement and the methods which suffice for the lax times of peace do not suffice for the sharp demands for quick results which are the result of war.

The problem which confronts the world today is solely transportation. Under the demands for the movement of unprecedented quantities of materials and manufactured products, not to mention the greatly increased passenger traffic of a military and commercial nature the facilities of the nation's railroads and travel arteries have been strained to the breaking point.

When it is considered that in this year, due to Government purchases more money has been spent in manufacture in this country than in many previous years combined, when every productive industry in the country has been pushed to the limit, it is but natural that the weak links in the chain should be quickly exposed. War plays an acetylene torch upon these weak lines, quickly burning them away and making us replace them with strong ones even while they are burning if we want to keep the chain intact.

Externally and internally we must keep things moving. We must move fuel, materials, manufactured articles, food clothing and armies both in civilian and military life. Transportation is the big demand of the age and with the railroads of the country taxed to their utmost limit, it is automotive transportation that must come to the rescue.

A century ago ideas of distance were gaged by the abilities of the horse. If we thought in terms of the horse to-day we might just as well surrender, yet there are over 100,000,000 acres of land cultivated annually in this country to support the horse. Nevertheless, the days of thinking in terms of the horse in transportation are done. Quick transportation, certain transportation and above all efficient transportation is the greatest demand of the age.

The change from a year ago to now has been a change of peace to war. We have been awakened from our gilded dream to find out that our Chinese wall of internal self sufficiency has crumbled. It has crumbled largely because transportation has advanced to such an extent that countries which in the days of "no entangling alliances" were

(*Concluded on page* 43)

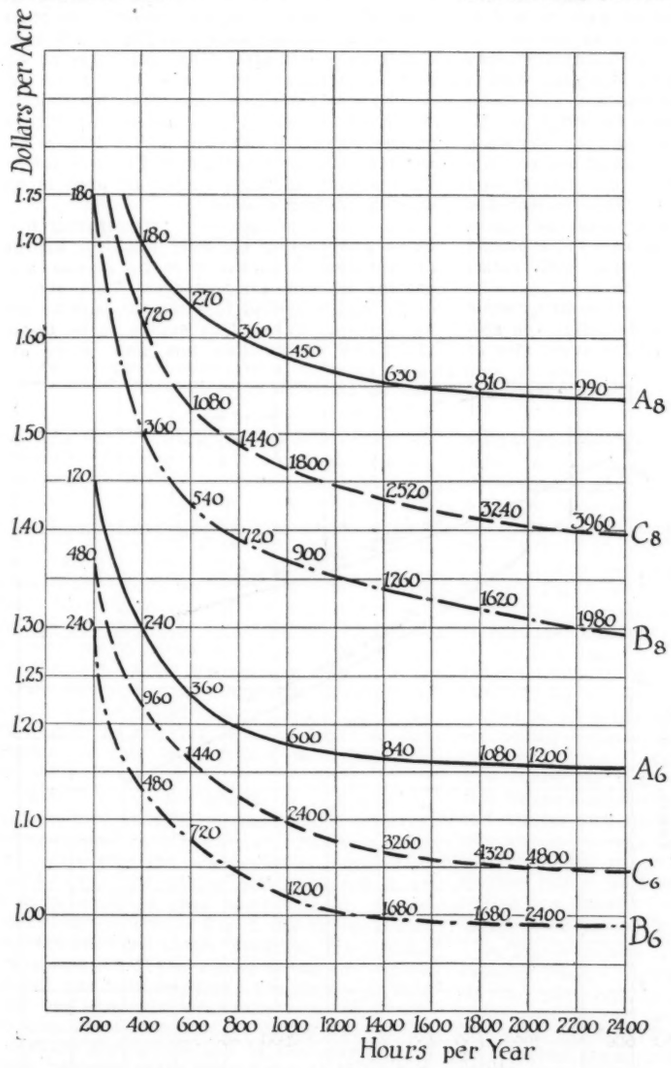


Fig. 2—Approximate cost of plowing 6 and 8 in. deep with three sizes of tractors, A, two-plow; B, four-plow; C, eight-plow. Figures show number of acres plowed in corresponding time

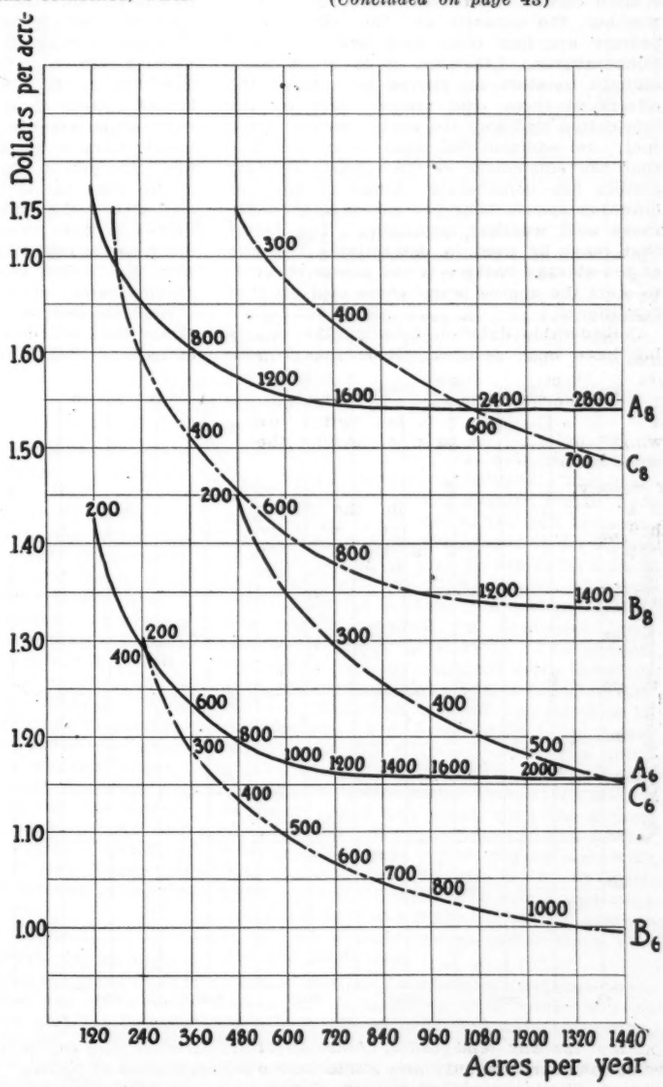


Fig. 3—Curve designed to make possible selection of economical-sized tractor for any number of acres to be plowed, together with time required and cost

Effects of Low Temperatures on Starting

By O. W. A. Oetting
Engineer Willard Storage Battery Co.

THE starting troubles encountered because of cold weather conditions such as we have experienced during the past three months are most exasperating to the car user but in the majority of cases are avoidable if all the effects of cold temperatures have been anticipated by the motor car designer. The proper applicatiton of the electric starter and storage battery for use on passenger cars, trucks and tractors presents problems to the engineer which, if properly solved, will prevent some of the troubles which frequently have occurred in the past.

Variety of Conditions

No apparatus is required to operate under such a variety of conditions as the automotive engine and its accessories. The range of temperature from the heat of summer to the freezing cold of winter is one of the conditions that must be appreciated in making the proper application of the storage batttery for this service. The storage battery can be made that will operate in a satisfactory manner under these extreme conditions, but engineers must take into consideration certain facts which do exist. In cold weather, the capacity and the voltage of a battery are less than they are at normal temperatures. Likewise, it is much more difficult to start an engine because of the effects of these cold temperatures on the lubrication and also the carburization of the fuel. In addition to these facts, we find that the efficiencies of the electric starting motors are considerably lower at the low cranking speeds that are encountered under these cold weather conditions. **The factor that must be used in determining the size of the storage battery is the power required to start the engine under these cold weather conditions.**

Considerable data on cold weather starting have been secured. It is the purpose of this paper, first, to give a short resume of these tests and, second, to summarize these results so as to predict, if possible, the size of storage battery that is required for starting any engine, giving the approximate ampere hour battery capacity in terms of the piston displacement of the engine.

Heretofore, not enough attention was given to the size of storage battery that was required on a car and almost invariably a smaller size of battery was used where a larger battery would have given better service under all conditions. This haphazard application of the battery shows great inconsistencies when a plot is made of the battery sizes against the engine displacements, as shown in Figure 1. The data for this plot are taken from a list of all the 1917 passenger cars and are no doubt representative of present-day practice. It can be seen that the 80 amp. hr. battery is used on cars having piston displacements from 95 to 425 cu. in. On the other hand, the 100 amp. hr. battery is used on cars with displacements ranging from 170 to 425 cu. in. Undoubtedly, cars with piston displacements over 200 cu. in. should be equipped with a larger battery than 80 amp. hrs. and those with displacements greater than 250 cu. in. should have a battery larger than 100 amp. hrs. The plot in Fig. 1 is true of course, only if the gear ratios between the starter and engine are the same. On the present-day makes of cars this is practically so, inasmuch as the majority of the cars are equipped with the single gear reduction with ratios approximately equal to 10 to 1.

With the purpose in mind of securing some factor that will determine definitely the size of battery that is required for every size of car, engines were tested with their starting motors and batteries in a large refrigerator to find the actual power required to turn over the engine at various temperatures. The exact minimum of temperature at which the engine should start promptly is of course debatable.

A temperature of 10 deg. Fahr. has been found to be a good basis for cold weather testing. If we take 10 deg. Fahr. as a cold weather standard and design the engine and all the automobile accessories to operate properly at this temperature, little trouble should be experienced during the winter months and satisfactory service from the apparatus will be assured.

Effects on Storage Battery

One of the effects of cold temperature on a storage battery is to lower the terminal voltage, especially at the high rates of discharge that are required by the starting motor. In Fig. 2 is shown "5-sec. voltage" curves of a 100 amp. hr. battery at 80 deg. Fahr. and at 10 deg. Fahr. By the term "5-sec. voltage" is meant the voltage that a battery will give at the end of 5 sec. at a certain discharge rate of current. In other words, the battery shown in Fig. 3 will have a voltage of 4.82 after 5 sec. discharge at 400 amp. at a temperature of 80 deg. Fahr. It will be seen from this curve that this battery would not be suitable for an engine with a starter requiring 300 amp. at 4.5 volts when the temperature was 10 deg. Fahr. or lower. Curves such as these should be used in all starting motors designs.

Fig. 7 is a picture of a refrigerating machine and cooling chamber used for testing an automotive engine with its starter and battery at low temperatures. This refrigerator can be cooled to a temperature as low as —30 deg. Fahr. The engine to be tested is placed within this box and wires are

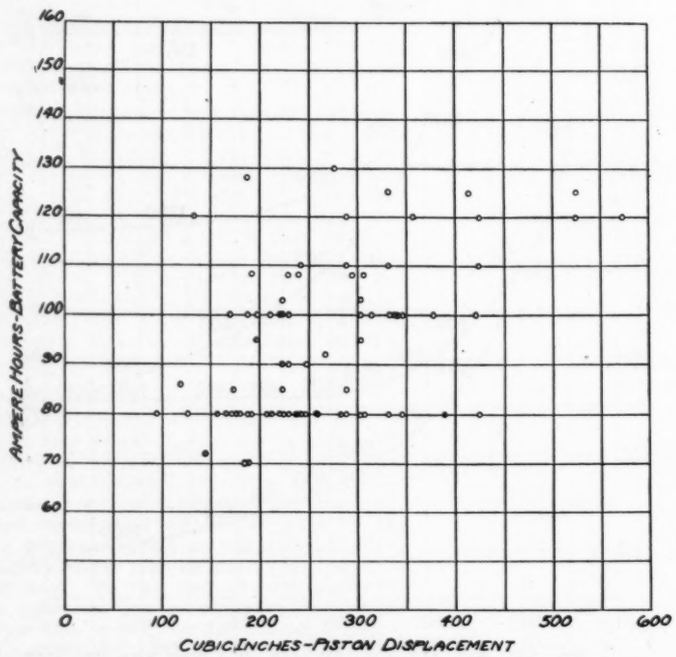


Fig. 1, above—Comparison of size of storage batteries with engine displacement on 1917 cars shows haphazard application of battery

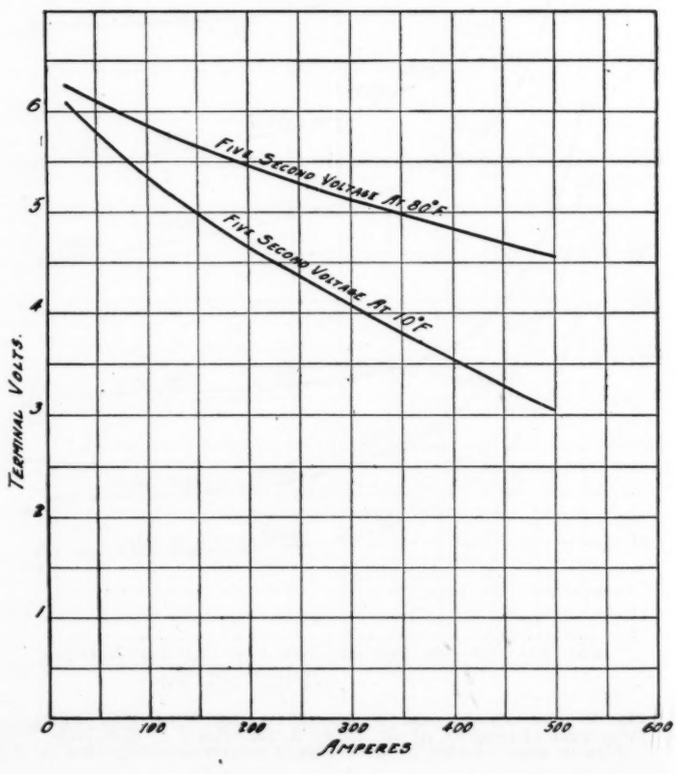


Fig. 2,right—Comparison of output of a 100 amp. hr. battery at different temperatures. At 10 deg. it drops too rapidly

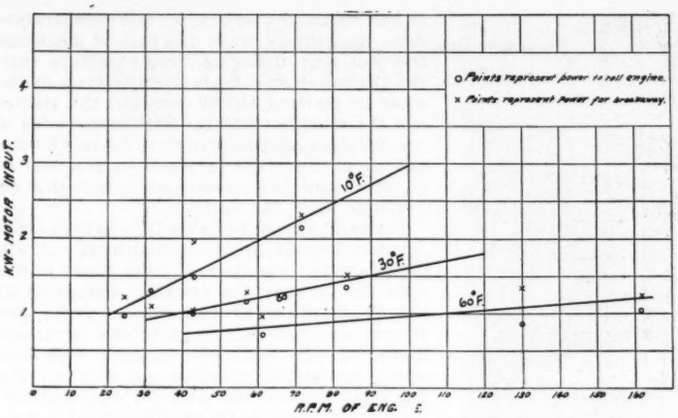


Fig. 3—Power required at different temperatures to start four-cylinder engine with 171 cu. in. displacement

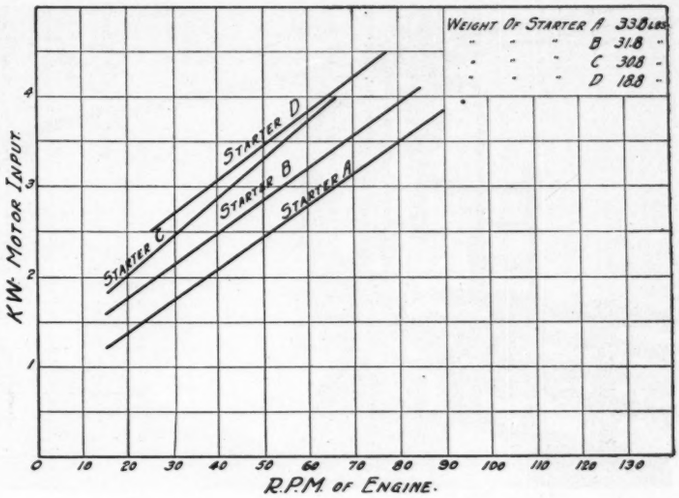


Fig. 4—Power necessary at 10 deg. for four different types of starters on same six-cylinder engine

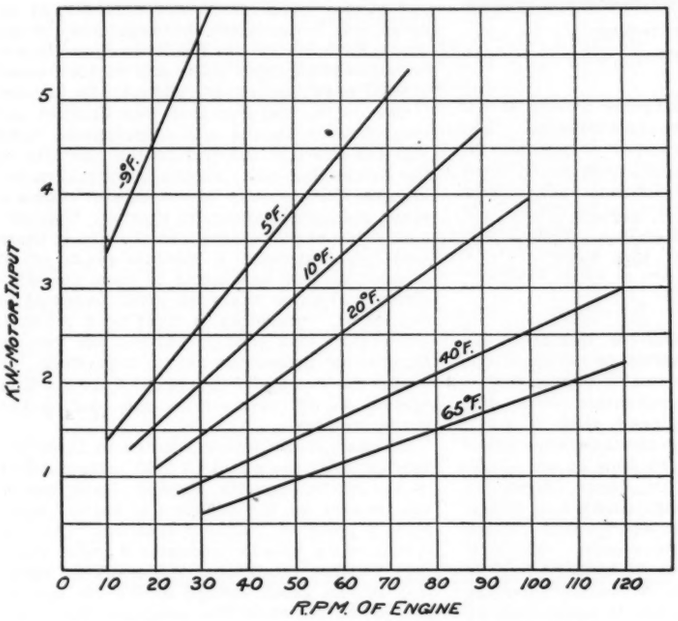


Fig. 5—Power necessary at different temperatures for starter on eight-cylinder with 332 cu. in. displacement

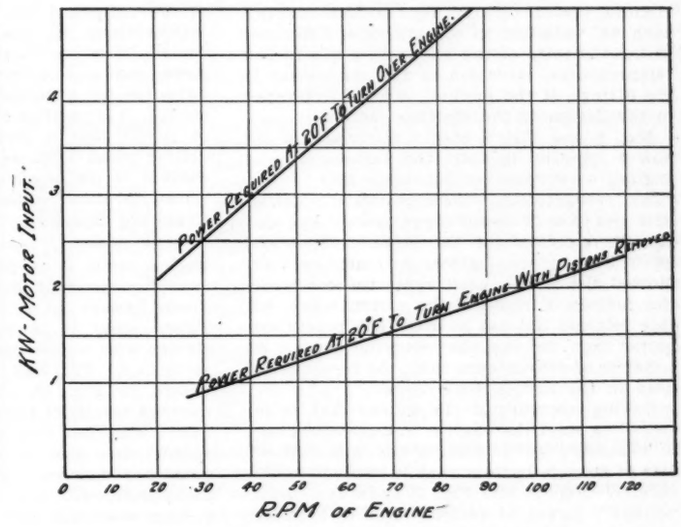

KW. MOTOR INPUT.
POWER REQUIRED AT 20°F TO TURN OVER ENGINE.
POWER REQUIRED AT 20°F TO TURN ENGINE WITH PISTONS REMOVED
R.P.M. OF ENGINE

Fig. 6—Power required to turn six-cylinder of 303 cu. in. displacement without pistons or connecting rods

brought out from the battery and starter to read the electrical input required to start the engine at low temperatures. A thermometer and some anti-freeze solution are placed in the cooling chamber of the engine and the temperatures can be observed from the outside of the box by means of a small observation door in the main door of the box. The revolutions of the engine are obtained by means of an electrical contactor scheme which rings a bell outside of the refrigerator. After the starting data are obtained at the normal room temperature, the box is slowly cooled to any desired temperature and the starting characteristics of the engine at this temperature are then observed.

Table I gives the results of a test on a certain four-cylinder engine having a piston displacement of 171 cu. in. The values in this table give the power that is required to break away the engine and then roll it at a certain speed and temperature. These results are plotted in Fig. 3, the curves showing the average power used for the breakaway and roll of the engine at various engine speeds and temperatures. The engine in this test had one cylinder which required about 50 amp. more than any one of the other three cylinders during the roll of the crankshaft. This, however, is the service that is demanded of a new storage battery on a car, as the engines often are not "run in" sufficiently before shipment is made by the car manufacturer. A 90 amp. hr. battery at a temperature of 10 deg. Fahr. turned over this engine at a temperature of 8 deg. Fahr. at 30 r.p.m.

A considerable variation in the power demanded from the storage battery is caused by a poor design and application of the starting motor. Fig. 4 shows curves of power used by four different types of starters on a certain six-cylinder engine. The light weight starter, D, requires about 1 kw. of power more than the starter A, in which the proportions of the various parts were more liberal. These curves indicate that the tendency to a lighter and cheaper starter will result in the necessity of the use of a larger storage battery. The motor car engineer must therefore decide where a compromise between the battery and starter will give the best economy and service. In the case of the engine in question, starter B was used. At 30 deg. Fahr. this starter with a 120 amp. hr. battery rolled the engine at a speed of 30 r.p.m.

Reason for Lower Tests

In Fig. 5 curves are shown on an eight-cylinder engine having a displacement of 332 cu. in. This engine was made by a well known engine manufacturer and the fittings of all the parts were well made. The results on this test were therefore lower in proportion to the size of this engine than some of the other engines tested.

A bad feature in the design of bearings was brought out in one of the cold temperature tests during these investigations. The bearing caps on one of the engines tested were made of aluminum, and at the cold temperature these bearings were found to be shrunk tight on the shaft, due to the difference in the coefficients of expansion of the two metals. During the test, it was observed that this engine required an unusually large amount of power to start it. The pistons, connecting rods and camshaft drive therefore were removed and the power required to turn the crankshaft and flywheel was found to be considerable. Fig. 6 shows that the power required for this latter condition was about a third of the total power required to break away and turn the engine without the pistons removed. At 6 deg. Fahr. with the pistons removed and 2.8 kw. supplied to the starter it was impossible to pry the engine loose with a 10-in. lever in the teeth of the flywheel. The results of this test gave values that were about 100 per cent higher than the average of all the engines tested under these cold weather conditions.

Other engines in addition to those mentioned in the foregoing were tested and all the results were averaged so as to determine, if possible, the power that is required to start any size of engine. It was found that it is hardly possible to lay down a hard and fast rule for this purpose, but a close approximation is possible. Average results on the

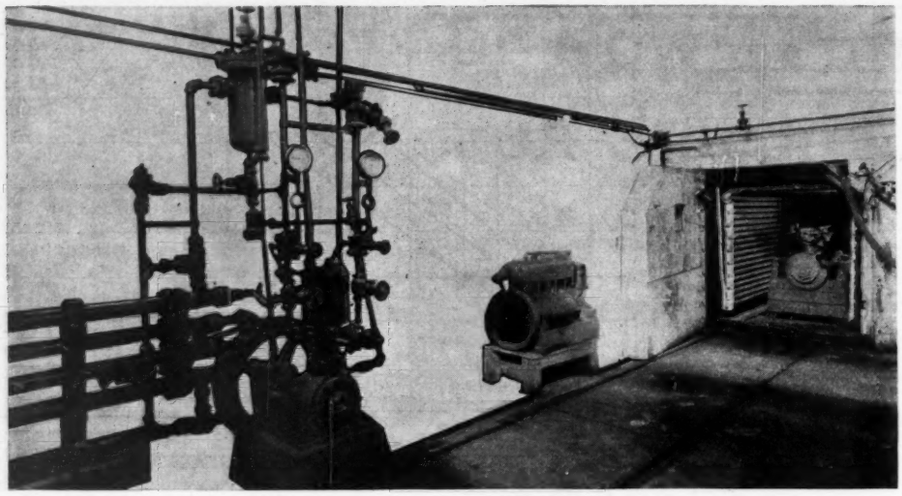


Fig. 7—Refrigerating machine and cooling chamber for testing engine with starter and battery at low temperatures

engines tested differed for various reasons, such as, variation in compression, difference in the viscosity of the lubricating oils at low temperatures, variation in the refinement in the fittings of the engine, and the difference in the design of the starting motors.

Fig. 8 and Fig. 9 give a summary of the power required to start the various sizes of engines at normal temperatures and 10 deg. Fahr., respectively. These curves are plotted with the axes of motor input against the piston displacement of the engine. It would have been more logical, perhaps, to have plotted the power used against the area of the rubbing surface of the piston walls, but this relation did not average the points any better than the one shown in the curve. As a matter of convenience then, the co-ordinates used in the curves were chosen.

Having ascertained the power that is required to start the engine, but one more step is necessary to determine the approximate size of storage battery that is needed for this service. Fig. 10 and Fig. 11 show the "5-sec. voltage" curves of various sizes of batteries at 80 deg. Fahr. and 100 deg. Fahr., respectively. The power that is available for 5 sec. from any of these batteries is the product of the volts and the amperes at any of the intersections of these co-ordinates. The dotted lines on these curves represent the power that can be obtained from any of these batteries for a period of 5 sec. From these curves, it is possible to determine the amount of power that a given size of battery will deliver when discharged at a certain rate of current or else discharged at some predetermined terminal voltage.

Cranking Speed

From these curves and the results of the engine tests, it is possible to estimate the cranking speed of any size of engine with a given battery at a temperature of 10 deg. Fahr. when it is equipped with a 6-volt starter with a gear ratio approximately equal to 10 to 1. This has been done in the curves shown in Fig. 12. This figure shows the average results of the engine speeds at 10 deg. Fahr. with the size storage battery plotted against the size of the engine. Table II gives the minimum size of battery that is satisfactory for use on a six-volt starting system when the gear ratio is approximately equal to 10 to 1. The basis for this data is the power that is required by the starter at 10 deg. Fahr. as shown in Fig. 9 and also that power which is available at this temperature from the battery when the rate of discharge is about four times its twenty minute rate. No allowance was made for the drop in the leads or starting switch between the starter and the storage battery. This drop varies in the different applications from 0.2 to 0.5 volts and should be made as small as possible, so as to utilize the maximum power that is available from the battery.

The values given in Table II have been indicated in Fig. 12 by the dotted lines. It will be noted that the battery sizes given in the table lie between the cranking speeds of 20 and 50 r.p.m. at 10 deg. Fahr. There are diverse opinions in regard to the minimum speed for successful starting, a condition which necessarily depends not only on the electrical system but also on the ignition, lubrication, and carburization of the fuel. The battery capacities recommended in Table II are the minimum sizes that will give satisfactory starting service at 10 deg. Fahr. in accordance with the average results of all these cold temperature investigations. Some engines may be found that will require larger batteries than these sizes, and in such cases greater capacities should undoubtedly be used

One of the features that was brought out very forcibly in the cold temperature tests was the effect of the cold on the viscosity of the lubricating oils. As the temperature decreases, the viscosity increases and causes a much greater resistance to turning. One certain grade of oil became a solid mass at these cold temperatures. A medium grade of oil in another test was found to have the consistency of extra heavy oil when cooled at 10 deg. Fahr. Therefore, a light or a medium grade of oil of a quality that will not lose its lubricating properties at 10 deg. Fahr. or hinder the successful operation of the starting system should be used on cars during the winter months.

Another of the features noted in these investigations, the effect of cold temperatures on the ignition system, showed clearly one of the reasons for the adoption of battery ignition in place of magneto ignition. At the low cranking speeds encountered under these cold weather conditions, the cranking speed was seldom rapid enough to fire the fuel in the cylinders when the magneto was used. However, when a battery of sufficient capacity is used to turn over the engine successfully, the battery voltage will always be high

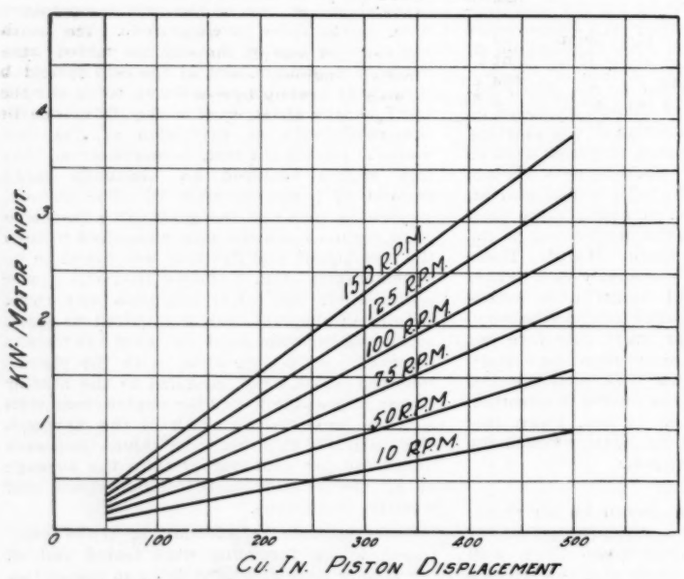


Fig. 8, above—Power required to break away and turn various sizes of engines at normal temperatures

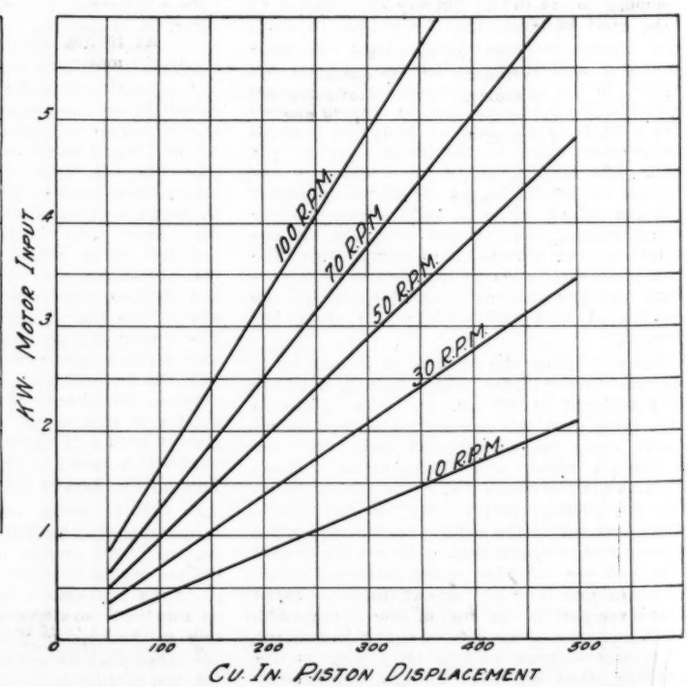


Fig. 9, right—Power required to break away and turn various sizes of engines at 10 deg. Fahr.

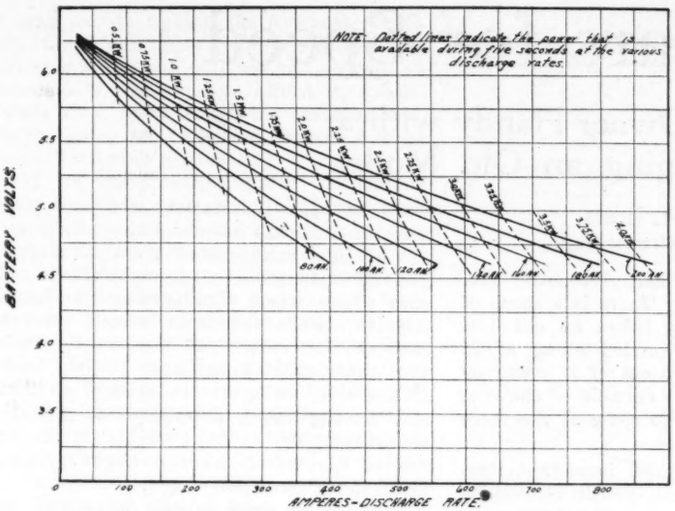

NOTE: Dotted lines indicate the power that is available during five seconds at the various discharge rates.
BATTERY VOLTS.
AMPERES-DISCHARGE RATE.

Fig. 10—Voltages of various sizes of batteries after 5 sec. discharge at 80 deg. Fahr. The dotted lines show power available during 5 sec. at the various discharge rates

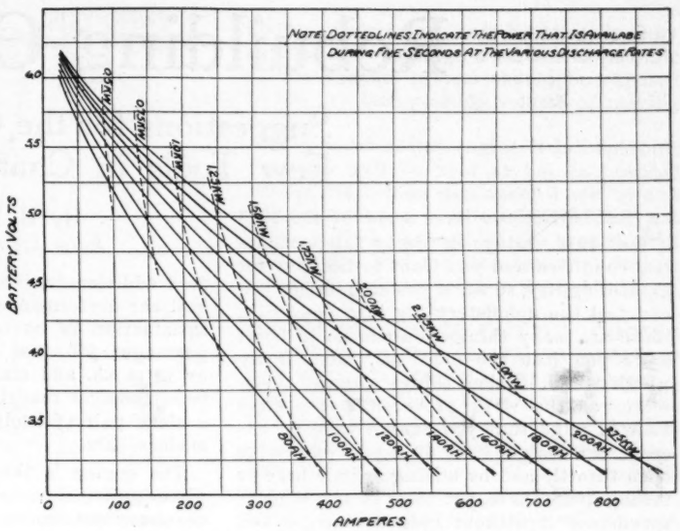

NOTE: DOTTED LINES INDICATE THE POWER THAT IS AVAILABLE DURING FIVE SECONDS AT THE VARIOUS DISCHARGE RATES
BATTERY VOLTS
AMPERES

Fig. 11—Voltages of various sizes of batteries after 5 sec. discharge at 10 deg. Fahr. The dotted lines show power available during 5 sec. at the various discharge rates

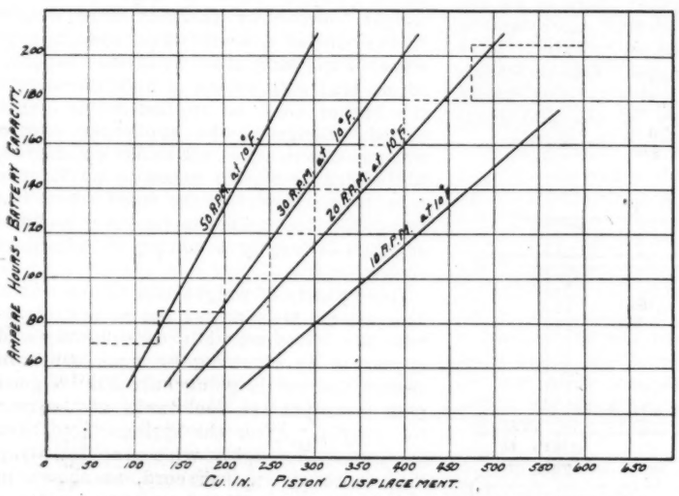


Fig. 12—Minimum battery sizes satisfactory for starting service for 6-volt starter with gear ratio about 10 to 1

Table I

Motor volts		Amperes		Watts		Speed temperature	
Break	Roll	Break	Roll	Break	Roll	R.p.m.	Deg. F.
4.75	4.0	200	175	950	700	61	60°
5.20	5	260	175	1350	875	130	60°
5.9	5.75	210	180	1240	1035	162	60°
4.15	3.60	245	275	1020	990	42.5	30°
4.60	4.25	280	270	1285	1150	57	30°
4.70	4.25	260	280	1220	1190	65.5	30°
4.50	4.25	275	285	1240	1210	66.5	30°
5.60	5.10	260	265	1510	1350	83.5	30°
3.90	3.4	310	280	1210	950	24.5	10°
3.70	4.2	290	310	1075	1300	31.5	10°
3.90	4.2	315	300	1230	1260	33	10°
5.80	4.5	335	330	1950	1485	43	10°
6.10	5.5	380	390	2320	2140	71.5	10°

Figures in columns headed "Break" are the instantaneous readings taken the moment the circuit closed.

Figures in columns headed "Roll" are the average readings taken while the motor was rolling.

enough to fire the engine equipped with a well designed battery ignition system.

The grade of fuel and also its carburization have a great influence on successful starting at cold temperatures. The installation of a good electrical system will be utterly negative in results, if the grade of fuel or poor carburization keeps the engine from firing. If the electrical system turns over a cold engine at some reasonably high speed, it should be unnecessary for the car user to be put to the inconvenience of heating the carburetor and manifold of the engine to cause the ignition of the fuel.

1—The size of a storage battery for starter service is determined by the power required to start and roll an engine at some reasonably cold temperature, 10 deg. Fahr. at a sufficient speed to cause ignition.

2—Starting troubles may be due to various causes, viz., lack of battery capacity, improper application or lack of size of the starter, viscosity of lubricant at cold temperatures, faulty ignition, poor carburization, or an inferior grade of fuel.

3—A good design of engine and its accessories should take into consideration all of these causes and provide for satisfactory starting at a temperature no higher than 10 deg. Fahr.

4—At 10 deg. Fahr., the available battery capacity is approximately 50 per cent of the normal capacity and the voltage at this temperature also is reduced to a considerable degree.

5—At 10 deg. Fahr. the efficiencies of the starting motors vary between 10 per cent and 40 per cent for the low cranking speeds encountered at these cold temperatures. A design of motor should be used which gives better starting torques and higher efficiencies at these low speeds, even if it is necessary to sacrifice the speed at which the motor spins the engine under normal temperatures.

6—A convenient double reduction gearing between the starter and the engine flywheel can be made that will give better starting characteristics under cold weather conditions than a single gear reduction.

7—A good quality of lubricating oil and a good grade of fuel are requisites for satisfactory starting.

8—As there is a wide divergence in the design and manufacture of the various automotive engines, each application should be tested separately to determine the power that is required to start it under cold weather conditions.

Table II

Engine size cu. in displacement	Battery size amp. hr.
Up to 125	70
125 to 200	85
200 to 250	100
250 to 300	120
300 to 350	140
350 to 400	160
400 to 475	180
475 to 600	205

For 6-volt systems with gear ratio approximately equal to 10 to 1. For starting systems of higher voltage or gear ratios greater than 10 to 1, the battery size can be reduced proportionally.

PREFERENTIAL COAL DISTRIBUTION

Washington, Feb. 25—Fuel Administrator Garfield has outlined a series of classes providing for preferential coal distribution. Class one includes consumers, class two necessary war industries, class three necessary peace industries, class four makers of so-called luxuries. The preferential distribution will be enforced by orders to coal operators and railroad embargos. A preferential board is to be created composed of four men selected from the Fuel Administration, Army, Navy and Shipping Board.

SPRINGFIELD BODY PLANT SOLD

Chicago, Feb. 22—The equipment and stock of the Springfield Body Co., Detroit, has been bought by Samuel L. Winternitz & Co., auctioneers, Chicago, to be sold at public auction within thirty days.

Rebuilding Cars for Speed

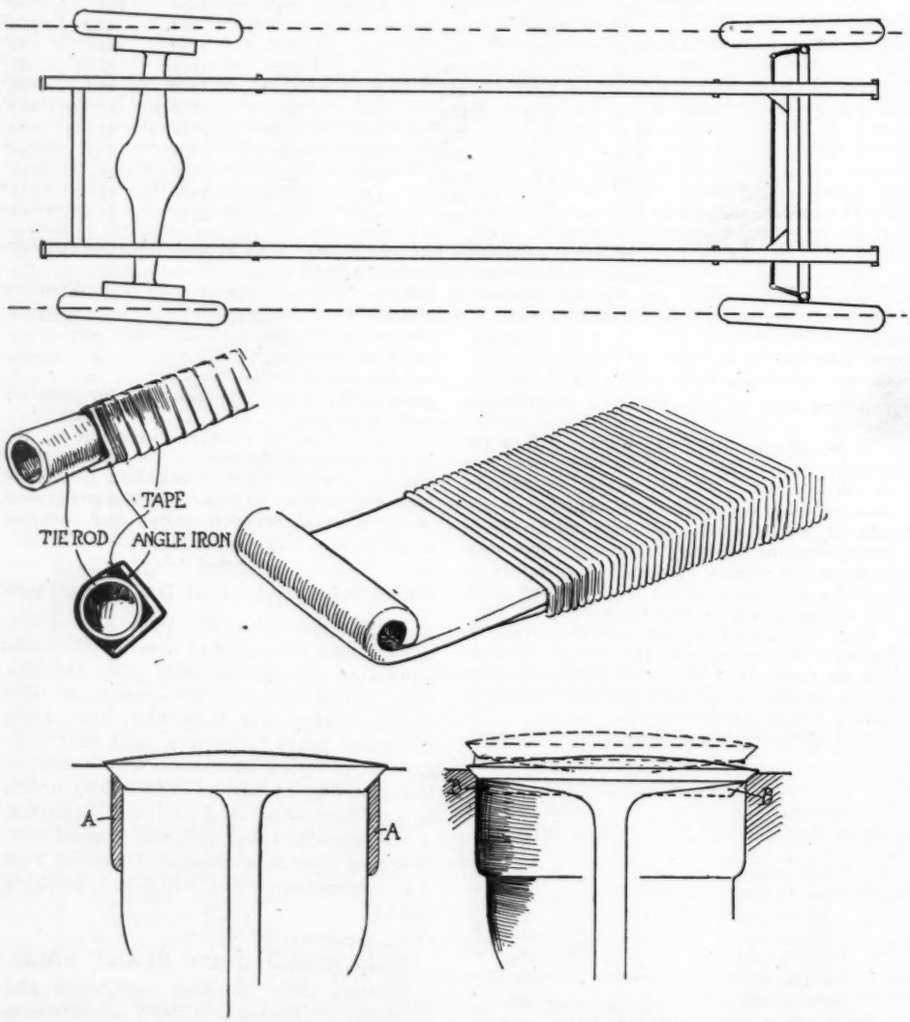
Suggestions for the Owner Handy with a Few Tools in Changing an Old Model

By B. M. Ikert
Motor Age Editorial Staff

ASSUMING you have a car of the 1913 or 1914 vintage in pretty fair mechanical condition and you want to tailor it for greater agility, so when you step on her you can feel the upholstery dig into your ribs, there are many things you can do to build more pep into the old boat, some really worth while. Other things suggest themselves as the work proceeds, but always bear in mind that you cannot take an average car designed for 50 m.p.h. with wide open throttle and by adding a little here or taking away there, put 15 or 20 m.p.h. more speed into it without radical changes and going to great expense. One possessed with a lust for extreme speed should not attempt to rebuild an old car but start right in on the drawing board and design a car from the ground up, whatever the expense.

Experience shows that it is not beyond the average owner handy with tools to make a few changes on his old car which will better the accelerating qualities, afford additional power and give better general car performance. There is a sense of satisfaction in having taken an old five-passenger job that rambled along at 35 or 40 m.p.h. and make out of it a snappy two-passenger roadster capable of showing a clean pair of heels to some of the more modern cars.

The engine is the most important item when tuning for speed, yet it is just as necessary to eliminate bearing friction or misalignment in the chassis if good results from doctoring the powerplant are to be realized. Resistance must be overcome before tackling the engine; there is no use in putting several hundred more revolutions per minute in the latter only to have them absorbed by dragging brakes, wheels out of line, etc. So get after the chassis first; make it worthy of the additional punch you expect to put in the engine.



Parts to consider when tuning for speed. Top, plan of car showing wheels out of line. Center, method of lacing angle-iron to tie rod and wrapping springs with cord. Bottom, how valves can be made more efficient by cutting away portion of seat and valve

One of the illustrations shows a plan view of a chassis on which the wheels are out of line, exaggerated greatly for purpose of explanation. It is especially in old cars where wheel misalignment is found. Almost always the front wheels have a tendency to spread at the front, while the rear axle sometimes settles back in one side, owing to the springs on that side having taken a permanent set. In checking up on the front wheels set the tie rod so the wheels have a slight gather, that is, toe in slightly.

The success wire wheels have had in racing would seem to warrant their use on a fast roadster. It is well known that more power is required to start a car whose wheels have a high peripheral weight. Naturally there is more weight in the rim of a wood wheel than a wire wheel of the same size. It further is pointed out that with wheels of high rim weight the brakes must be applied for a longer period. Longer brake application means wear on the tires, so, all things considered, the choice in wheels seems to be for the wire type. However, the wood wheel has many excellent points in its favor and the question is largely a matter of individual choice.

Have plenty of weight over the rear axle. This affords traction for the wheels, otherwise the latter may slip considerably and appear to be traveling 60 m.p.h. when in reality the car is going only 50. A good plan is to put the fuel tanks at the rear for weight. After the springs have been lubricated thoroughly with graphite, wrap them with strong fish cord, as shown in the illustration. This keeps the lubricant in and dust out. It also serves to dampen the spring action. If the springs have been removed put them back on the car before winding, as the weight on them will restore them to the normal position.

Lessening Wind Resistance

See that the brake bands do not rub, as much power will be absorbed in this way unnoticed. To detect it, have some one push the car along and if any grinding noise is heard in the brakes they should be adjusted.

The subject of wind resistance brings us to the body. At normal speeds, of course, the shape of the body is of little effect, but for fast work the streamline type of body is the thing. Avoid as much as possible flat surfaces. Especially is this true of the car's rear. Have the body as narrow as possible and smooth-sided. Such a body does not absorb much power at high speeds or in head winds. Place as many of the fittings, pumps, etc., as you can on the inside to keep down resistance. You can reduce the resistance of the front axle by placing a piece of triangular-section wood in the channel and taping it in place. In the same way the tie rod and drag link can be strengthened by taping a piece of angle-iron over them as shown in the illustration.

If you want the car for high speeds only

it may pay to lighten the flywheel, which sometimes will give quicker accelerating power but the car will not run so well at low speeds. If you can afford it, substitute a steel flywheel for the cast-iron one. Or the latter can be turned down in a lathe and a steel ring shrunk on.

Of the reciprocating parts the pistons come first in importance. For very high speeds they can be reduced in diameter slightly to prevent binding. Again, they can be lightened by drilling or substituting alumium alloy, light gray iron or steel pistons. The latter must be made very accurately and fitted to prevent seizing. They can be made tapering, having, say, from 0.005 to 0.006-in. clearance at the top and tapering to about 0.002 in. from the wristpin down. If cast iron pistons are used, they sometimes can be reduced in weight by machining the interior, cutting them off slightly or drilling holes in them.

If the pistons are drilled to a great extent, considerable more oil may be necessary at high engine speeds. Really the best thing to do if the owner wants to reduce piston weight is to take the matter up with some concern specializing in this work and fit the pistons recommended by such companies.

Valve Port Areas

It happens sometimes that there is a notable falling off in power at a certain speed after lighter pistons have been fitted. This is because the valve port areas are too small to take care of the added volume of inrushing gases. Larger valves and ports afford a remedy and will be discussed further on. Should steel pistons be fitted and the latter have a tendency to warp under excessive heat, they should be taken out and the high spots eased off. Of course, as the clearance is increased the engine may not perform well until it becomes heated and the clearance normal.

In lightening the connecting rods all the cutting away should be restricted to the web and wristpin end, for it is the reciprocating parts that must be reduced in weight. A famous race driver once said he would rather add 20 lb. to the chassis than 1 oz. to the pistons or connecting rods. Pistons and connecting rods must weigh exactly the same. The weight distribution throughout the length of the rods must be identical, as otherwise the engine will be out of balance. One of the illustrations shows how connecting rods can be weighed for equal weight distribution.

Existing conditions will dictate to a great extent just what can be done to make the valves more efficient. If possible the intake valves should be made larger and the exhausts left alone, as nowadays the chief difficulty is to get the gas into the cylinders. The burnt gases, as a rule, get out quick enough. But while you are about it, you might as well increase the latter also.

If the same valves are to be used, the aperture below them may be enlarged by cutting away portions of the seat, as shown at A. The objection to this is that it leaves only a narrow face and the valve soon burns out. A good procedure is to cut away the metal from under the valve head, shown by the dotted lines. This leaves a face of sufficient width and gives the gases a better flow. A portion of the fillet also can be cut away, but take care not to weaken the valve. Obviously the valves

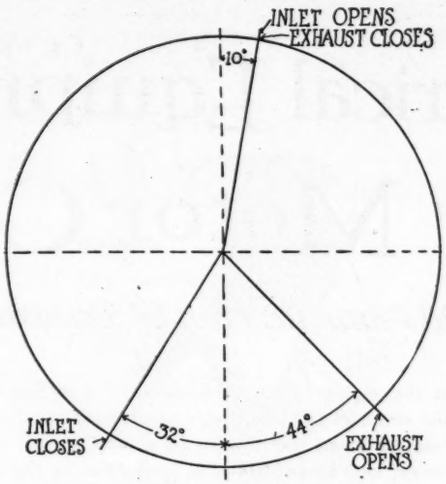


Diagram showing suggested time of opening and closing valves on speed car

should be ground in so they seat perfectly. A good plan, too, is to fit stronger springs, and to prevent binding in the guides at high speeds the stems of the exhausts should be slightly diminished.

Opinion is more or less divided as to timing the valves. Each engine requires its own particular timing, and it is impossible to give data along this line outside of a few suggestions. Experiments show that the exhaust valve should open somewhere between 35 and 40 deg. before bottom center. But as we want to scavenge the cylinders well it may be better to open the exhaust earlier, say 44 deg. The inlet opens immediately the exhaust closes and this takes place about 6 to 12 deg. after top center. Generally the point of closing the inlet valve is somewhere between 20 and 50 deg. after the piston has reached the crank end dead center. As shown in the diagram 32 deg. has been selected for closing the inlet.

The disposition of the burnt gases is important, and other things being equal the exhaust pipe should be carried well to the rear of the car. Easy bends are essential, and within reasonable limits the longer the pipe the better the results. This is so because the velocity of the burnt gases rushing through the pipe produces a scavenging effect and literally sucks the gases out. A sudden bend means increase in back pressure, the gases impinge on the bend and set up resistance. Tests show that acute bends become red-hot before other portions, showing that the hot gases dash very rapidly against these bends. Not only do sharp bends, etc., create resistance, but indirectly the power of the engine is reduced by the inability of a good portion of the burnt gases to leave the cylinders on the exhaust stroke. Thus, the incoming fresh charge is diluted considerably and the full force of the next explosion not altogether realized.

Keep the exterior part of the pipe clean from mud and oil. The cooling surface can be improved also by giving it a coat of lamp black. See that the inside of the pipe is smooth. The actual degree of roughness on the interior has a resisting effect to the flow of gases. Experience has shown that there is a certain practical length of exhaust pipe which gives the best power effect when the engine is required to give its maximum horsepower at a certain number of revolutions per minute. The actual length, however, can only be determined by experiment. As large a surface as possible of the exhaust system should be exposed to the greatest possible volume of moving air.

In a water-cooled engine it is important that the wall be kept as hot as possible during the intake and exhaust stroke and just hot enough so the mixture does not ignite before the end of the compression stroke. For best results a temperature just below the boiling point is desirable.

PERSIA GASOLINE OUTPUT GROWS

Washington, Feb. 22—This country may look to Persia after the war for increased supply of gasoline to operate the thousands of cars, trucks, airplanes and so on that are expected to be in post-war service here. For the Anglo-Persian Oil Co. already is producing 150,000 tons of gasoline a year, and it is estimated that this will amount to 600,000 or 700,000 tons annually after the extensions are completed. The oil fields that are being developed and tested are said to be among the most extensive and richest in the world. Were refineries available to deal with the oil, the field from which crude now is being produced would give about 4,000,000 tons a year. Most of the wells, as it is, have to be kept shut down for want of facilities to deal with the crude.

Crude obtained in Persia contains a very large percentage of gasoline and kerosene of high quality, as well as excellent lubricating oils, fuel oils of high thermal utility and a good percentage of first-grade paraffin. The cost of production is lower than in some other countries, as the crude is obtained from the wells in great volume, requiring less field expenditure.

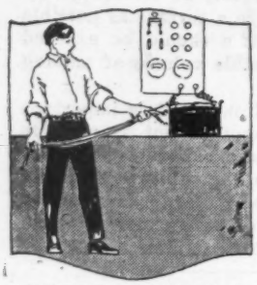
TRUCKS FOR BELGIUM

Chicago, Feb. 22—The Belgium consul general advises that a powerful Belgian colonial firm, Societe Belge Industrielle et Miniere du Katanga, 36 Avenue de Neuilly, Neuilly s Seine, France, wishes to receive catalogs from manufacturers of motor trucks and tractors, together with those of mining machinery, hydraulic mining machinery, hydro-electric machinery. The firm wants to compare different designs, and prices will be agreed on at the time of giving the orders.

ST. LOUIS USED CAR SHOW

St. Louis, Mo., Feb. 25—A used car show will be held in the Exhibit building, where the annual motor car show was held last week, beginning March 18. The permanent features of the decorations will be used for the later show.

The decision to hold the used car show was reached at a call meeting of the St. Louis Automobile Manufacturers' and Dealers' Association after the show closed Friday night. President Schlecht named the following committee: R. C. Frampton, of the Hudson Phillips Motor Co., chairman; Ed Weber of the Weber Motor Car Co., Phil H. Brockman of the De Luxe Automobile Co., C. W. D. Donnelly of the Supreme Motor Co., P. S. Anderson of the Packard-Missouri Motor Co. The committee selected Capt. Robert E. Lee, who was manager of the show just closed, as manager. On Saturday twenty-four dealers signed space applications.



Electrical Equipment of the Motor Car

By David Penn Moreton & Darwin S. Hatch.

Editor's Note—Herewith is presented the eighty-fourth installment of a weekly series of articles begun in MOTOR AGE, *issue of June 29, 1916, designed to give the motorist the knowledge necessary to enable him to care for and repair any and all of the electrical features of his car, no matter what make or model it may be. At the conclusion of this series, "Electrical Equipment of the Motor Car," with additions, will be published in book form by the U. P. C. Book Co., Inc., New York, in a size to fit the pocket conveniently.*

A thorough explanation of the fundamentals of electric circuits preceded descriptions of the general types of starting, lighting and ignition apparatus, signalling devices, magnetic transmissions, etc. This is being followed by the installation, care and repair of individual systems, beginning with the special equipment for Fords.

Part LXXXIV—Westinghouse System for Ford Cars

THE Westinghouse starting and lighting equipment for the Ford car is a single-unit, 12-volt, single-wire system. The regulation of the generator is by the third-brush method.

Preparing Engine for Mounting

Check all the material to see that there are no parts missing. Adjust the ignition and carbureter so that the engine is running smoothly before dismantling any part of the engine. Remove the radiator and both water connections, the three forward left-hand cylinder bolts, as shown in Fig. 459, the fan and its bracket complete, and the Ford timer. Turn the engine crankshaft so that the pin in the fan pulley is in a vertical position, Fig. 459, and drive the pin out and remove the starting crank and fan pulley.

Use a bulldozing tool to expand the front end of the engine oil pan, Fig. 460. This tool may be purchased from the Westinghouse company. It is extremely important that at least ⅜-in. clearance beyond the driving sprocket, which is to be mounted on the engine crankshaft, be obtained as shown in Fig. 466. The bulldozing tool should be used with the spacing hub, always next to the engine. The tool is made so that it may be used for right-hand and left-hand operations equally well.

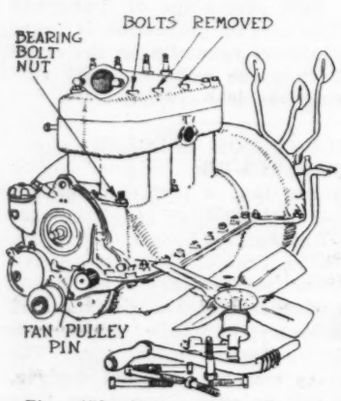


Fig. 459—Ford engine prepared for installation of Westinghouse starting and lighting

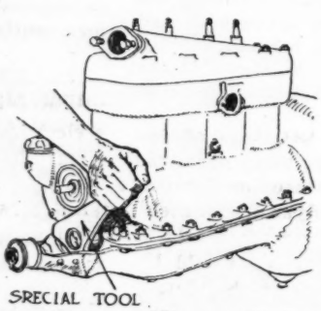


Fig. 460—Method of using special bulldozing tool to expand front end of engine oil pan

Mounting Crankshaft Sprocket

The crankshaft sprocket is assembled at the factory and adjusted to the proper tension. Dismantle the sprocket. See that the hole in the end of the crankshaft is in a vertical position, and then drive the Westinghouse sprocket hub, Fig. 461, so that the hole in the sprocket hub is in line with the hole in the crankshaft. The sprocket hub must be a tight fit on the crankshaft and should be driven into place by a copper or brass bar as shown in Fig. 461. Drive the hub pin, Fig. 461, through the sprocket hub and shaft, and be sure that the headed end is flush with the surface of the hub. If the pin is not a tight fit in the shaft, it should be bent a slight amount at the center so as to make it tight. Use a drift, Fig. 462, for driving the pin into place so as not to injure the pin or hub. To be sure that the pin is not pro-

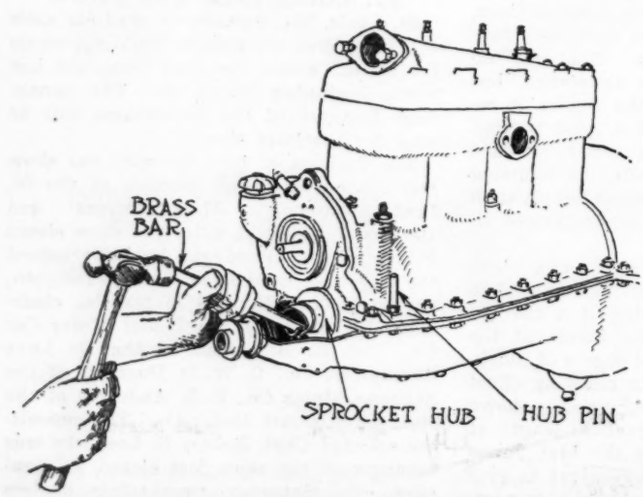


Fig. 461—Mounting the Westinghouse driving sprocket on the engine crankshaft

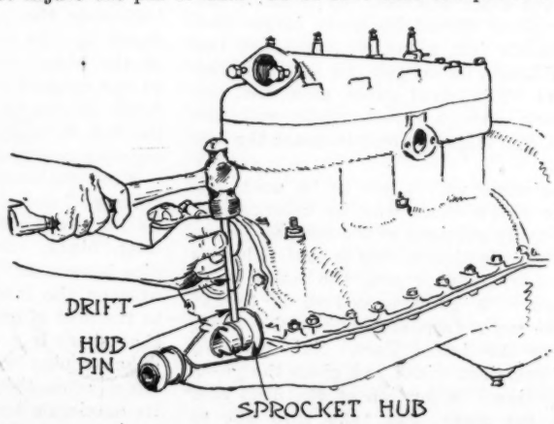


Fig. 462—Method of using drift in inserting sprocket pin in hub

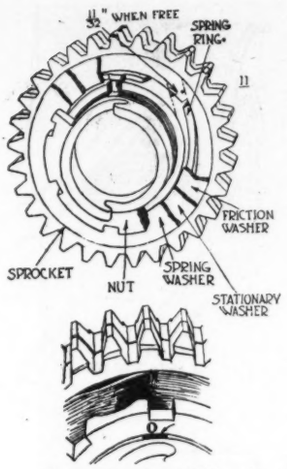


Fig. 463—Assembly of Westinghouse crankshaft sprocket and its adjustments

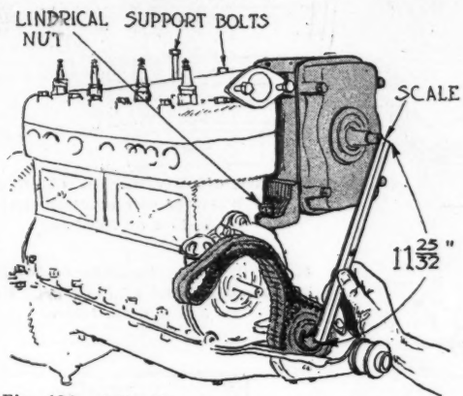


Fig 464—Adjusting the distance between the centers of the crankshaft and the shaft of the electrical unit. This distance should be exact

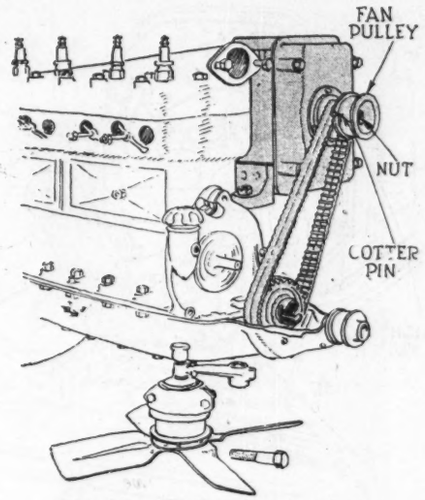


Fig. 467—Shaft pulley in place, lightening the mounting bracket

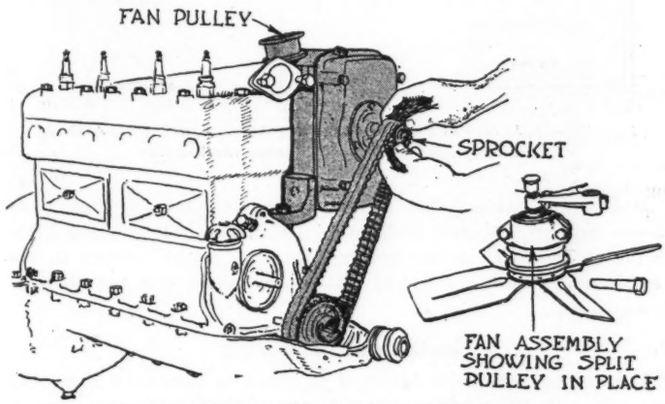


Fig. 465—Placing the sprocket on the electrical unit with the chain in place on both the sprockets, and fan assembly

jecting too far at the extended end, place the sprocket on the hub and turn it several revolutions. If the sprocket does not turn freely, the pin probably strikes inside and should be trimmed down until it just clears.

Remove the sprocket and place one of the friction washers, Fig. 463, on the hub. Now spring the spring ring into place on the hub so that the small hole in the ring engages with the projecting end of the small pin. It will not go into place any other way. Be sure that the free end of the spring ring projects at least $\frac{7}{16}$ in. out from the surface of the sprocket hub, Fig. 463.

Place the chain under the sprocket hub. Slide the sprocket over the spring. Pack the sprocket with cup grease and place the other friction washer on the forward side of the sprocket. Now place the stationary washer over the keyway in the sprocket hub, and put the spring washer on the outside of this and fasten it in place with the nut, as shown in Fig. 463. The nut should be tightened until the mark "O" on the nut corresponds with the mark in the keyway A on the hub, lower part of Fig. 463. The grooves in the face of the nut should register with the flutes of the spring washer.

Remove the nut from the forward left-hand bearing bolt and replace it with a special flat Westinghouse nut, as shown in Fig. 461. Place the lock washer on top of this nut and screw the cylindrical nut down tightly to the lock washer. Replace the Ford timer.

Mounting Electrical Unit

Set the Westinghouse electrical unit, Fig. 464, in place on the engine, using in the cylinder head the three special screws furnished for this purpose and the special cylindrical nut provided. Adjust the center distance between the engine crankshaft and the shaft of the electrical unit, as shown in the figure. This distance should be $11\frac{25}{32}$ in. as shown, and all three points of support should touch.

Remove the sprocket from the shaft of the electric unit, Fig.

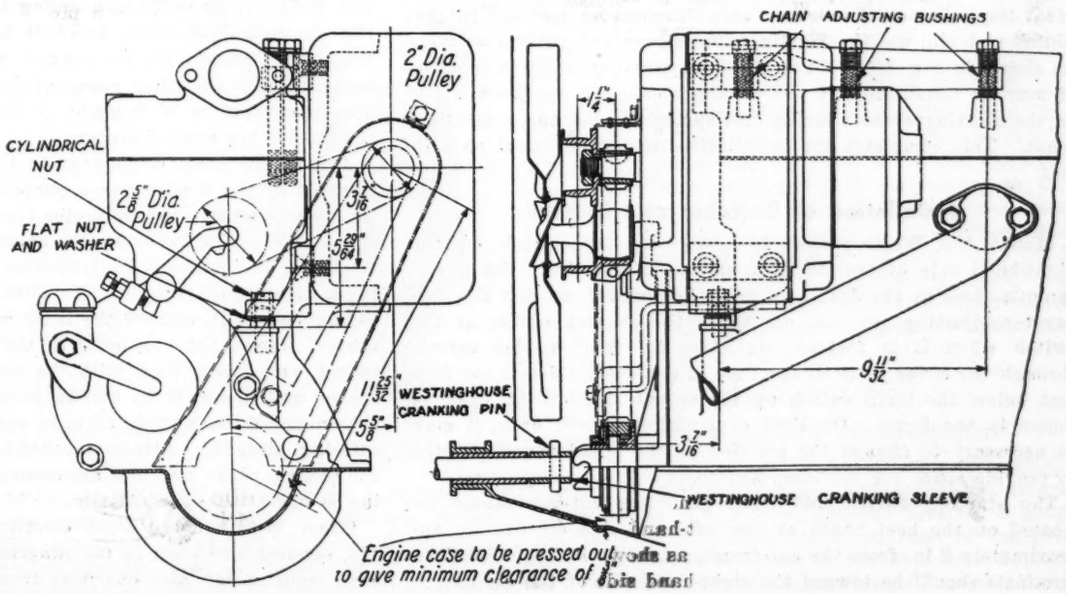


Fig. 466—End and side views of Westinghouse starting and lighting installation on the Ford engine, showing the correct position of the different parts on engine

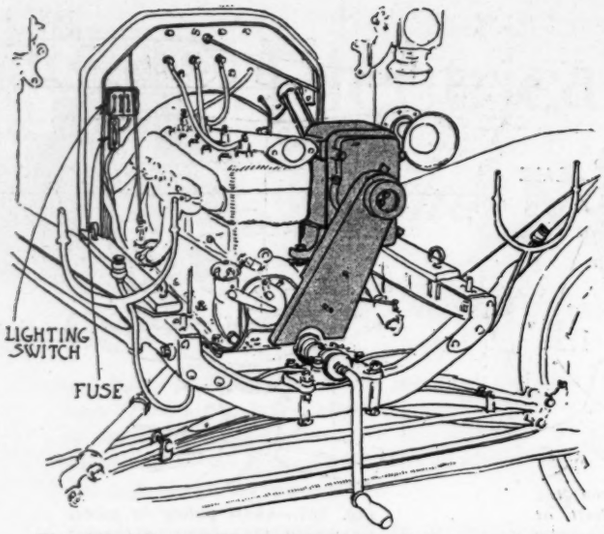


Fig. 468—View of Westinghouse installation on the Ford car, showing chain guard in place and part of the wiring

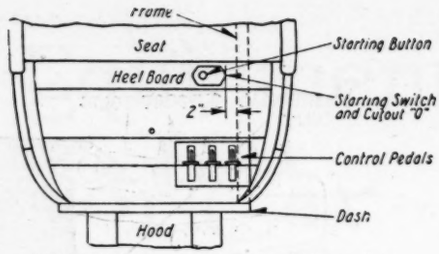


Fig. 469, above—Diagram showing location of Westinghouse starting switch and cutout on Ford car

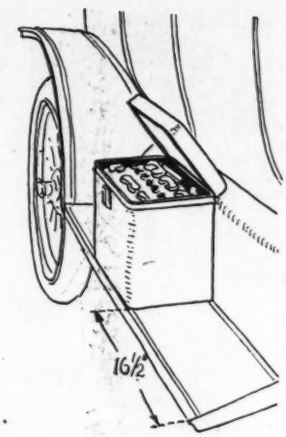


Fig. 470, right—Location of battery box on running board of Ford car, Westinghouse installation

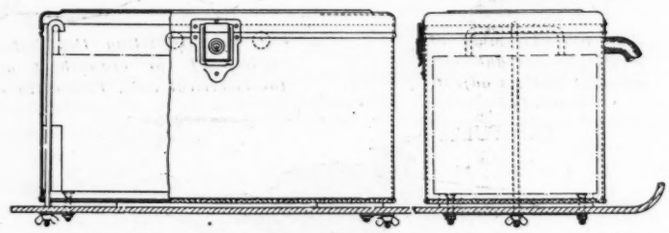


Fig. 471—Side and end views of battery box mounting on running board of Ford car, Westinghouse installation

465. Insert the sprocket in the endless driving chain and press the sprocket on the shaft as shown in the figure. When the sprocket is in place there should be at least 10 pounds tension on the chain. If the tension on the chain is less than 3 pounds, adjust the center distance as directed in the following paragraph until required tension is obtained.

A new silent chain is elastic to some extent and for this reason a new chain is adjusted to run at about 10 pounds tension. After several hundred miles of running, the chain may be loosened so that it strikes the chain guard. This is a sure warning that it is time to tighten the chain and it should really not be allowed to run until this occurs. Loosen the three bolts, Fig. 466, about one full turn from the top supporting bracket. Tighten the adjusting bushing nearest the radiator until chain tension is correct, and then set other bushing to agree and tighten all support bolts. Do not run the chain under tension after it has been stretched. If the chain is too tight it will produce a grinding noise. When properly adjusted, after the chain has been service for at least 2000 miles, it should give about ⅜ to ½ in. when pressed upon with the fingers.

After replacing the fan pulley and tightening the nut, be sure to replace the cotter pin, Fig. 467. Mount the chain guard in place and see that it lines up, as shown in Fig. 468.

Clamp the split fan pulley on the Ford fan pulley as shown in Figs. 465 and 466, and replace the fan on the engine using the new fan belt. The fan blades should be bent slightly so as to clear the pulley on the electric unit. Instead of the Ford ratchet clutch and pin, use the Westinghouse sleeve and pin respectively as shown in Fig. 466. When the Ford starting crank is replaced it may be found slightly out of alignment. If so, insert a bar in the starting crank bearing and spring the bearing into alignment. This completes the installation of the electrical unit itself.

Installation of Switches and Battery

Mount the Westinghouse two-gang lighting switch on the right-hand side of the dash, as shown in Fig. 468. Cut a rectangular hole in the dash at a point low enough so that the carbureter-adjusting rod will not touch the contact screws of the switch when it is fastened in place by four wooden screws through the cover plate on the face of the dash. Mount the fuse just below the lamp switch on the engine side of the dash as shown in the figure. On Ford cars with the cowl dash, it may be necessary to change the position of the speedometer slightly to provide space for the lamp switch.

The starting switch and hand generator cut-out should be located on the heel board at the left-hand side of the car, approximately 2 in. from the car frame, as shown in Fig. 469. The terminals should be toward the right-hand side of the car.

Mount the battery box on the right-hand running board, as shown in Fig. 470, and drill two ¾-in. holes in the splash plate to match the holes in the battery box. Place the battery in the box as shown in Fig. 471, and fasten it in place with the holding-down bolts.

Installing the Wiring

The wiring should be fastened in place as shown in Figs. 472 and 473. If Westinghouse lamps are used, the dimmer should be removed. All the holding cleats should be fastened under bolts already on the Ford chassis, except where wood screws may be used to attach the holding cleats to wood parts. Be very careful that the various cable terminals do not touch any part other than the stud to which they are supposed to be fastened. Failure to observe this precaution may result in the apparatus being seriously damaged or the battery ruined before the car is ever run. It is equally essential to prevent the metal armor on the cables from touching any of the connecting studs or terminals. The ground wire should be fastened at one end under one of the supporting bolts of the starting switch and cut-out and at the other end by fastening the connection, together with the cleat for W-2, under the bolt holding the brake and clutch rod to the frame. Do not connect the ground wire W from the battery until all other wires are in place and fastened. The ground connection W is made by fastening the connection under the bolt of the muffler support.

Attach the lamp connectors to the wires. These connectors, as made by the Westinghouse company, are of the solderless type. To connect remove the connector from the lamp. Slip the casing, see A in Fig. 474, back over the cable and push the wires through the collar B. Remove the insulation from the ends of the wires for a distance of about ¼ in. With a small screwdriver applied to the sleeves D, remove the little metal socket C from the connector. Insert the bare ends of the wires into the holes in the socket, and fasten them with the small set screws. Replace the socket and fasten it by screwing up on the sleeve D. Be sure that none of the strands of bare wire project outside of the insulating piece E. Attach the head and tail lamps, insert the connecting plugs and try all circuits to determine that everying is operating satisfactorily.

When Westinghouse Ford electric headlamps are used, Fig. 473, connect as shown in the diagram, grounding one wire from each lamp socket, also one wire from the tail-light socket. One

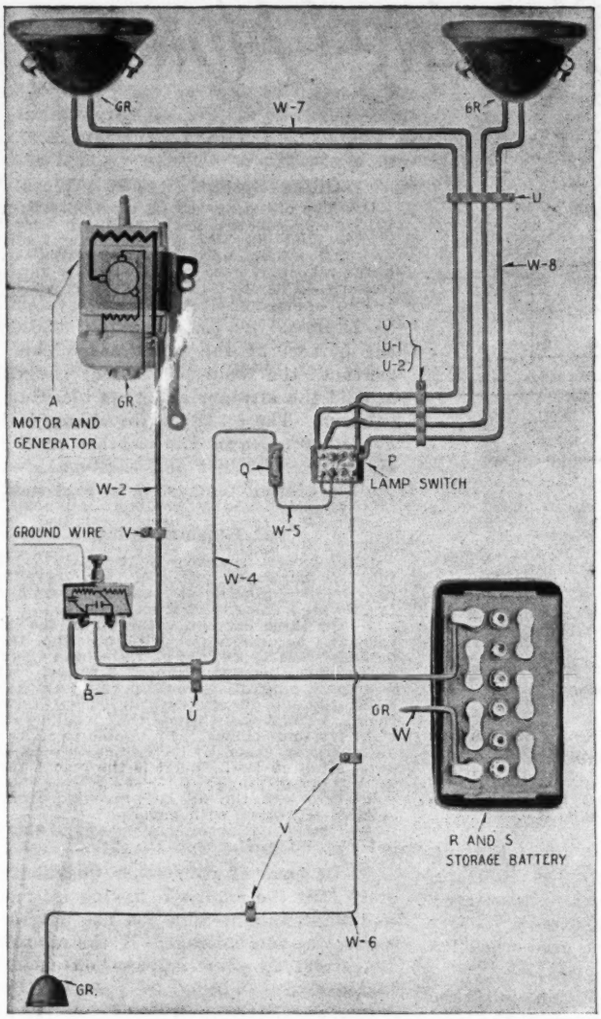


Fig. 472—Wiring diagram of Westinghouse system on Ford car with other than Westinghouse lamps

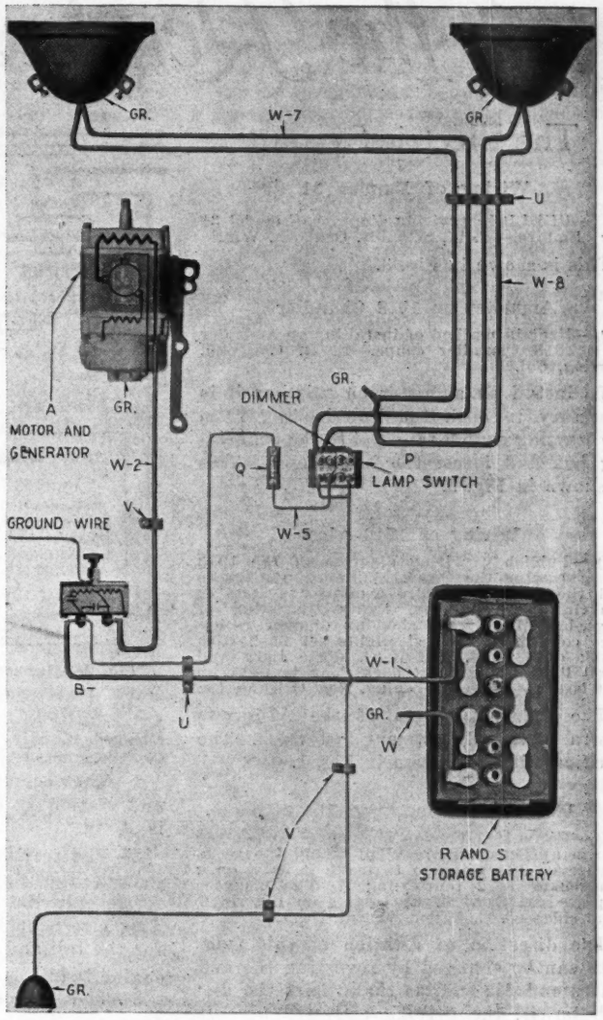


Fig. 473—Wiring diagram of Westinghouse system on Ford car with Westinghouse lamps installed

switch button will give dim lights, and the other switch button will give bright lights. If two-wire double-bulb lamps are used, one wire from each lamp socket must be grounded to the lamp housing or car frame, as shown in Fig. 472, and the dimmer should be disconnected. If side lights are used instead of double-bulb headlights, with two-wire lamps, both wires in calbes W-7 and W-8 can be used for the headlights, as shown in Fig. 472, the dash end of one wire in each cable being grounded instead of connecting to the switch. An additional wire should be run from the switch to one terminal of each side lamp, and the other terminal of the lamp grounded. The dinner should be disconnected. If side lights are used instead of double-bulb lamps, with single-wire lamps, both ends of one wire in cable W-7 and W-8 are useless and should be taped. An additional wire should be run from the switch to each side lamp, and the other terminal of the lamp grounded. The dimmer should be disconnected.

TO SELL DETROIT-WYANDOTTE

Detroit, Feb. 22—The Security Trust Co., receiver for the Detroit-Wyandotte Motor Truck Co., Wyandotte, Mich., maker of the Horner truck, is offering the plant and business of that concern for sale. The plant went into receivership in January on account of lack of working capital. The inventoried assets are $200,000 and the liabilities, $85,000. It is understood that an offer of $125,000 will be considered.

U. S. GOOD ROADS MEETING

Savannah, Ga., Feb. 23—The official call for the sixth annual session of the United States Good Roads Association to convene in Little Rock, Ark., April 15 to 19, has been issued by United States Senator J. H. Bankhead, president of the association. In connection with this convention will be an exhibit of road models, road scenes, machinery and road materials. Col. Charles H. Brough of Arkansas is the first vice-president of the association, and he has sent an invitation to every governor to attend and appoint 100 delegates.

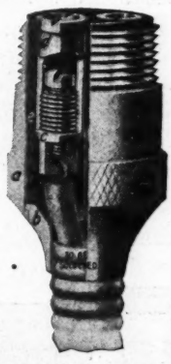


Fig. 474—Details of Westinghouse lamp

BLAIR TO CHANGE HANDS

Newark, Ohio, Feb. 23—The Blair Motor Truck Co. of this city, will within a week or ten days sell all of its assets to a new corporation to be known as the American Motor Truck Co. The new concern will continue to manufacture the truck and will take over the entire good will of the Blair organization. The new company is in the process of organization at the present time and soon will announce its new officers.

TRIPP HEADS PRODUCTION

Washington, Feb. 22—Guy E. Tripp, heretofore chairman of the board of directors of the Westinghouse Electric & Mfg. Co., has been appointed head of the production division of the Ordnance Department, with headquarters, of course, here.

The Readers' Clearing House

The Electric System

Wiring of Empire 31

Q.—PUBLISH a wiring diagram of model 31 Empire.—F. W. Schmidt, Oshkosh, Wis.

This is shown in Fig. 3.

Ammeter on 1918 Chandler

Q.—Explain method of installing an ammeter on a 1918 Chandler coupe.—Z. R. Chipman, Sterling, Col.

To install an ammeter on this car it is necessary to open the line leading from the starting switch terminal to the connecting box and insert the instrument. This is shown in Fig. 2.

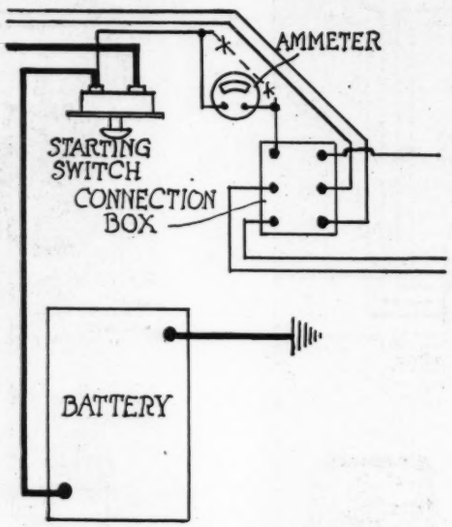


Fig. 2—Manner of connecting an ammeter on 1918 Chalmers

Wiring of 1913 Alco

Q.—Publish a wiring diagram of the 1913 Alco, showing the Bosch high-tension magneto and the two-wire Apelco generator system of charging and lighting, lights consisting of single-bulb headlights showing dimmer resistance connection; two sidelights set flush with dash; cowl light, tail light, dome light and small light under right back door to light up foot board.—George Downing, New Orleans, La.

The lighting system of the Alco was shown in this department last week. The ignition wiring is given in Fig. 1.

Wants Anti-Clockwise Magneto

Q.—Can a high-tension Sims magneto be made to run anti-clockwise? What would I have to change on the magneto to make it work on a Studebaker 1912 four-cylinder? The magneto is placed in front of the engine on the right-hand side.—J. G. Miller, Vernal, Utah.

The direction of rotation of this magneto can be changed by reversing the end plates end for end, so that where the distributor is, the driving end will be. It also requires a new contact breaker. The distributor and armature gear setting also will have to be changed. As this work requires an experienced workman, we would suggest that you send the magneto to the manufacturers' service station.

Ford Electrical Queries

Q.—What should be the correct space between the Ford magneto and the magneto coil?

2—Would the use of a rectifier for transforming the alternating-current to direct weaken the magneto for the Ford magneto?

3—Could this storage be used for ignition also?—W. E. Paullus, Moccasin, Mont.

Q.—Do you advise the use of counterbalanced weights on Ford crankshaft?

2—What is the weight of a Ford chassis, stripped of body, fenders, running boards and radiator?—W. E. Paullus, Moccasin, Mont.

1—The correct distance between the and stationary coils in the Ford magneto is $\frac{1}{32}$ in.

2—The rectifier does not affect the output of the Ford magneto, as it transforms only the surplus current generated. This can be utilized to charge a battery for the tail and side lamps, used when the engine is idle.

3—The current for ignition is taken from the line before it reaches the rectifier. There would be no object in doing this, as the magneto was designed to furnish current for ignition and any that is generated in surplus of these requirements can be used for whatever purpose the operator desires. This surplus can best be utilized for lights as suggested above.

It is said that the counterbalances improve the smoothness of operation of the Ford engine. These are manufactured by the Dunn Counterbalance Co., Clarinda, Iowa.

2—The weight of the Ford chassis stripped as mentioned is about 1100 lb.

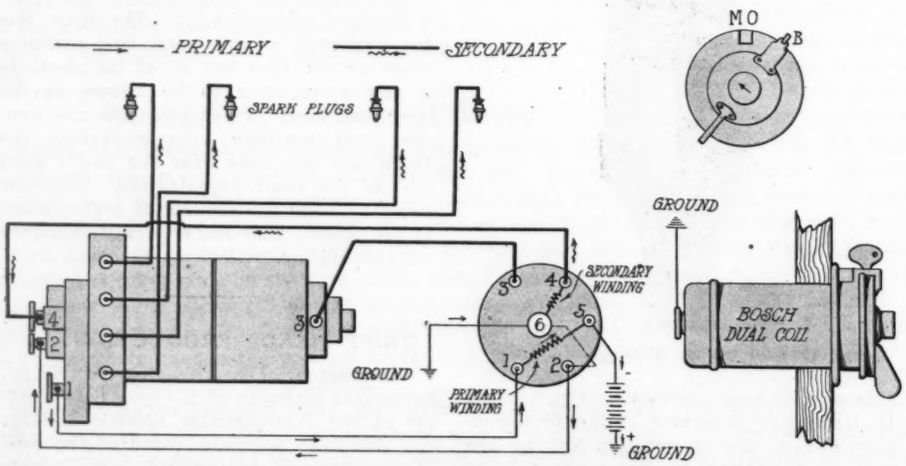


Fig. 1—Wiring diagram of Bosch dual ignition system on 1913 Alco

Lubrication

Oiling System Does Not Work

Q.—The oiling system on my Dodge Brothers 1915 model car will not work in cold weather. I have used different brands of light oil, but they all stiffen up and won't circulate. It works all right when the weather is not below freezing.—Charles E. Wilson, Sharpsville, Ind.

The operation of the oiling system can be improved by removing the strainer at the bottom of the crankcase. This will prevent the cold oil from congealing around the strainer and thus blocking circulation. The oil should be changed about every 500 miles in cold weather, as the old oil will collect dirt and thus make easier the blocking of the system in cold weather.

Oil Becomes Diluted

Q.—I have a Chalmers light six, 1917. I obtain 10 m.p.g. of gasoline. My traveling is nearly all on good level roads in a small town. Is this all I can expect from my car?

2—On three occasions, the oil in the crankcase has become mixed with gasoline, the oil becoming nearly as thin as water and the fresh oil becomes this way in about 3 weeks. I have had spark plugs that would produce a spark become oily and heavy carbon deposit form on them. After being cleaned they would work all right for some time. I am unable to climb hills on high gear, generally have to go on second and quite often on low. What is the reason for the missing spark plugs?

3—How can the oil be prevented from becoming saturated with gasoline?

4—How can I increase the power of this car?—H. W. Stick, Hanover, Pa.

1—In some of your other questions you state that the engine is having oil trouble and this explains why you are not receiving better fuel mileage. If the oil trouble is corrected, your mileage on fuel will increase.

2—This condition of oil fouling the plugs is caused by the oil passing the pistons, commonly referred to as oil pumping. The thinner the oil becomes in the crankcase the greater the possibility of the spark plugs becoming fouled. Sometimes this can be checked by using a heavier oil, and if this does not succeed in stopping the trouble it then probably will be necessary to install new piston rings in the engine. If the pistons have too great a clearance between themselves and the cylinder walls it will cause this condition to exist. Various types of non-leaking rings have been devised to overcome this trouble, and if a set of these are installed your trouble will be corrected.

3—The dilution of the crankcase oil is caused by the unburned portions of the fuel passing the pistons and entering the crankcase. This condition is at its maximum when the engine is coldest. When starting a cold engine, as in the morning, more of the unburned fuel passes into the crankcase than at any other time, due to the fact that there is insufficient heat in the engine to burn all the fuel. This condition can be overcome partially by replacing the cold cooling water in the morning with hot water. With the present fuel it is almost necessary to change the crankcase oil about every 500 miles, regardless of the make of engine, to prevent what has happened in your case. If the lubricating oil in the crankcase becomes diluted with more than 25 per cent of gasoline and kerosene it is necessary to change

the oil, as if the car is continued in service there is a possibility of burning out the engine bearings.

4—Nothing can be done to increase the engine power until it is rid of the oil trouble. However, see that the carbureter is set as lean as possible to produce a running mixture and have the spark plug gaps set at 3/32 in. If the type of spark plug you are using fouls with unusual rapidity you might try another make. We would suggest that you take the car to the party from whom it was purchased and have him give you an opinion regarding the condition of it and what steps should be taken to correct the trouble.

Engines

Horsepower of Oldsmobile

Q.—What is the horsepower rating of the Oldsmobile Aristocrat Model?—Anselm Warner, Hepburn, Iowa.

The N. A. C. C. rating of this engine which has a bore of 5 in. and a stroke of 6 in., is 40 hp. at a piston speed of 1000 ft. per minute.

Greatest Number of Revolutions

Q.—What piece of machinery makes the greatest number of revolutions per minute? What is the number which it makes?

2—How many revolutions do the best airplanes of the United States make per minute?—Fairy Gazaway, Happy, Tex.

1—Motor car engines have been known to attain crankshaft speeds as high as 4000 r.p.m. Perhaps one of the fastest power machines is the small steam turbine, which attain rotor speeds as high as 40,000 r.p.m.

2—The propeller speeds of an airplane seldom exceed 1600 r.p.m., as beyond that speed the efficiency of the propeller begins to decrease. The limits of propeller speeds in actual practice vary from 1200 to 1600 r.p.m.

Peculiar Scores in Cylinders

Q.—I have a Hudson Super-Six which has been run 4800 miles. The machine knocked and I thought I would have the carbon taken out of the engine. Upon taking off the cylinder head, I found in four of the cylinders a couple of depressions, practically wavy lines like those shown in sketch. The machine has been kept well oiled. Do you think these are scored cylinders? I always supposed that if the cylinder was scored it would have a number of light scratches in its perfectly straight up and down, the way the piston would cut them, but these lines waver from side to side.—Subscriber, Oshkosh, Wis.

This is a very peculiar condition and apparently has been caused by some foreign substance getting either into the cylinders or lubricating oil. It is not probable that this would be caused by broken rings or loose piston pins, as it has occurred in four cylinders. Neither does it seem that it could be due to a flaw in the casting, on account of its happening in so many cylinders. However, we would suggest that you examine the crankcase lubricating oil and note if there is any abrasive substance in it.

Wants Oversized Pistons for Buick

Q.—We have in service a Model C-36 Buick for which we have been trying to get oversized pistons. We have learned that the Buick company does not furnish oversized pistons for any of its models and I have been wondering whether there will be any objection to using oversized Dodge Brothers pistons in this engine. Both have a 3 7/8-in. bore. The Dodge Brothers piston is longer and lighter in construction than the Buick. Not only is the former piston skirt longer, but the distance from the center of the piston pin to the top of the piston is 1/4 in. greater. The explosion chamber in the Buick cylinder is not counter-bored. Do you think the difference in the pistons would cause a knock or affect the running or efficiency of the engine in any way? Would the engine have as much power as before? Would the change unbalance the moving parts?—C. W. Paull, St. Louis, Mo.

On account of the distance between the center of the wrist pin and the top of the piston being 1/4 in. greater on the Dodge Brothers pistons, it would be impossible to use them. This is due to the fact that the Dodge Brothers piston would increase the compression beyond that for which the engine is intended. We would suggest that you try to get a set of unmachined Buick piston blanks and after having the cylinders reground, then have the piston blanks machined to fit the reground cylinders. In regard to the balance of the moving parts, the new pistons should have the same weight within close limits. If you have the cylinders reground and new pistons fitted, be very careful in limbering up the engine and treat it the same as you would a new car, as by speeding up or racing the engine with the new pistons before they are properly worked in you can do more damage than through a year's normal service. The power output under these conditions will be as great as any of the other models of the same make.

TO assist readers in obtaining as a unit all information contained in this department on a certain subject in which they may be most interested, such as ignition, carburetion, etc., MOTOR AGE has segregated inquiries into classes of allied nature. Questions pertaining to engines will be answered under that head, and so on.

THE ELECTRIC SYSTEM
F. W. Schmidt.....Oshkosh, Wis.
Z. R. Chipman.....Sterling, Colo.
George Downing.....New Orleans, La.
J. G. Miller.....Vernal, Utah
W. E. Paulius.....Moccasin, Mont.

LUBRICATION
Charles E. Wilson.....Sharpsville, Ind.
H. W. Stick.....Hanover, Iowa

ENGINES
Anselm Warner.....Hepburn, Iowa
Fairy Gazaway.....Happy, Tex.
Subscriber.....Oshkosh, Wis.
C. W. Paull.....St. Louis, Mo.
L. Orchard.....Adelaide, Australia
A. Z. Scott.....Bowen, Ill.
M. M. Hanson.....Clearwater, Neb.

CARBURETION
Louis Meyer.....Kewanee, Wis.
Floyd H. Fulmer.....Mishawaka, Ind.
Alvin Siler.....Palouse, Wash.
Charles E. Wilson.....Sharpsville, Ind.
J. R. Stewart.....Lawrence, Kan.

MISCELLANEOUS
Floyd H. Fulmer.....Mishawaka, Ind.
C. L. Davidson.....Bell Buckle, Tenn.
Ray Baker.....Sheridan, Wyo.

REBUILDING
John B. Berxlogilo.Twin Bridges, Mont.
H. Johnson.....Warren, Wyo.
Charles Hughes.....Victoria, B. C.
L. L. Smallwood.....Regina, Sask.
Subscriber.....Cincinnati, Ohio

No communication not signed by the writer's name and address will be answered in these columns.

Reader Explains Trouble

Adalaide, Australia, Editor MOTOR AGE—Referring to your issue of Nov. 10, 1917, in the Readers' Clearing House section, page 35, Hugh C. Russell, Kearns Canyon, Ariz., writes under the heading, "Engine Runs on Two Cylinders."

I have had exactly this same experience and I can assure you it took some locating. Your answer states in effect what the trouble is, but does not mention exact seat of the trouble. Doubtless by this time the matter is fixed, but all the same I would like to give my experience with regard to the trouble.

One of the side brushes on the make-and-break dust cover of the magneto has to do with the four dry cells placed alongside the vacuum tank. If these cells are worn out and short with each other, or with the metal box in which they are kept, they will transmit the short to the magneto, effecting the make and break and causing the engine to fire on the two outside cylinders only, with an intensified spark. This is evident because with the engine running on two cylinders, by disconnecting the dry cell wires it immediately will run on four cylinders. Put new dry cells and proper insulation between each cell, including bottom, and the metal box will rectify the trouble.—L. Orchard.

Figuring Engine Compression

Q.—What is the compression and how found of an engine of the following dimensions: 11 3/32 in. bore, 13 in. stroke, with 1 1/2 in. clearance above piston when on top dead center, valve-in-head type? How much clearance should the same type of engine have above piston for 50 lb. compression?—A. Z. Scott, Bowen, Ill.

The compression ratio of an engine is the ratio of the clearance volume to the total volume of the cylinder. The total volume of the cylinder is the piston displacement plus the clearance volume. The piston displacement of a cylinder is equal to $\frac{d^2\pi S}{4}$, where d is the diameter of the cylinder in inches, π is the constant,

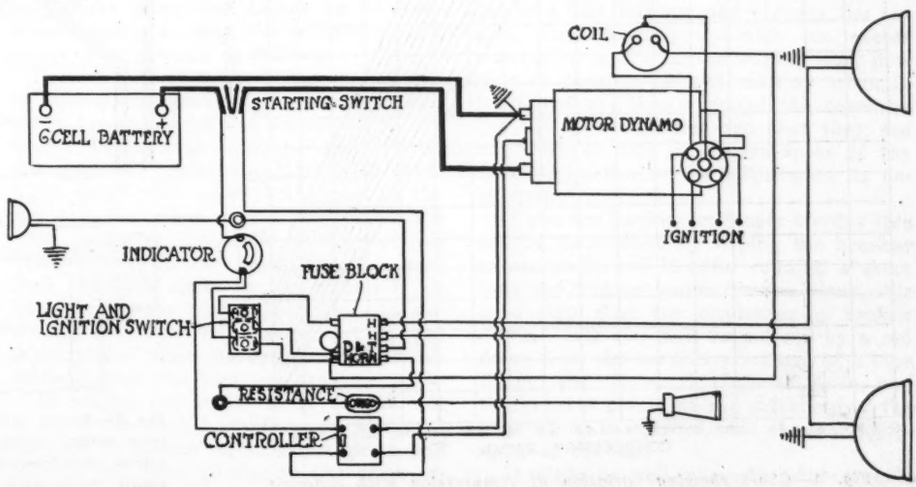


Fig. 3—Wiring diagram of the Remy starting and lighting system used on the Empire 31

3.1416, and S the length of stroke in inches. To determine the clearance volume use the same equation, but let S equal the distance between the top of the piston head and the head of the combustion chamber in inches, when the piston is on top dead center.

The piston displacement of a cylinder of the size mentioned is 1253.2 cu. in. and if the combustion space is considered as cylindrical in shape the clearance volume is 144.6 cu. in. when using the value 1.5 in. The total volume is the sum of these two values, or 1397.8 cu. in. By dividing the total volume by the clearance volume the comparison ratio is found to be 9.66 to 1. The compression ratio in actual practice usually varies from 3 to 5 to 1, and from this it will be seen that the clearance volume is not large enough.

The chart shown in Fig. 4 illustrates the compressions for various compression ratios in terms of absolute pressures. The absolute pressure is equal to the gage pressure plus 15 lb., which is equivalent to atmospheric pressure. Thus for a gage pressure of 50 lb. the absolute pressure is 65 lb. The initial pressure usually is assumed to be about 13 lb. and crossing on the chart at the 65 lb. line to the 13 lb. initial pressure line, the ratio is found, by dropping vertically, to be 3.55 to 1.

With a compression ratio of 5 to 1, the clearance volume is equal to 20 per cent of the total volume of the cylinder and for a compression ratio of 3.55 to 1, the clearance volume is equal to 28.15 per cent of the total volume. Now multiply the total volume 1397.8 by 28.15 and the result is 393 cu. in., or the volume of the clearance space, which will give a compression of 50 lb. gage. Then using the equation given above for the clearance volume, substitute the value of the clearance space in terms of cubic inches and knowing the diameter of the cylinder solve for the value S. This is found to be 4.07 in., or the distance between the piston head and combustion chamber head when the piston is on upper dead center, to give a gage compression of 50 lbs. By a similar calculation you can determine the distance between the piston head and combustion chamber head any other compression within the limits of the chart. The limits of the chart are sufficient for all forms of internal combustion engines.

Rotary Valve Designs

Q.—In the Dec. 27 issue and again in the Jan. 10 issue of MOTOR AGE mention was made of rotary valves for gasoline engines. Illustrate and describe such rotary valves as have been tried and proved a failure. Also state who have used such valves in practical operation.—M. M. Hanson, Clearwater, Neb.

There have been so many different types of rotary valve constructions that it is impossible to describe them all in these columns. Some of them have worked out very well in practice, while others never got beyond the theoretical stage. One of the chief difficulties to overcome in rotary valves is that of keeping them tight. In some designs the pressure of the cylinders is depended upon to keep the valve disks in firm contact with the seats. This pressure is excessive at times, and if lubrication is not proper the valve is short-lived. Some of the different forms of rotary valves are shown in Fig. 5.

Carburetion

Adjusting Schebler R Carbureter

Q.—Give directions for adjusting model R. Schebler carbureter.—Louis Meyer, Kewanee, Wis.

Before adjusting the carbureter make sure that the ignition is timed properly and that you have a hot spark at each plug; that the valves are timed and seated properly and that all connections between the intake valves and carbureter are tight and there are no leaks of any kind in the connections. Also adjust the carbureter when the engine is quite warm.

Refer to Fig. 7. By turning the air valve A clockwise the needle valve E is

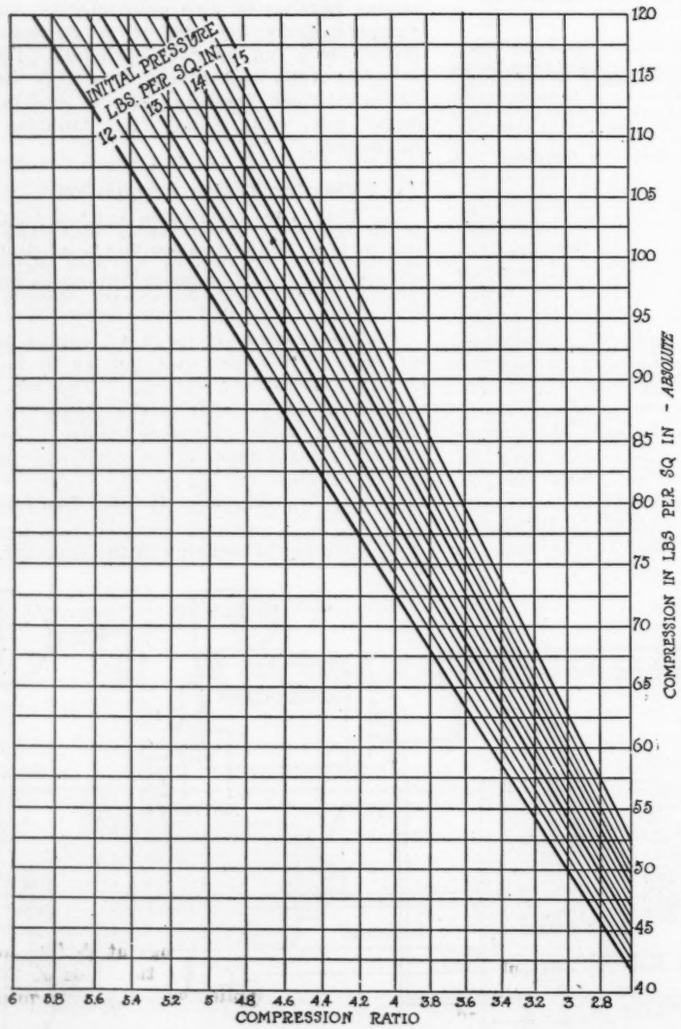


Fig. 4—Chart showing variation of compression with different compression ratios at different initial pressures

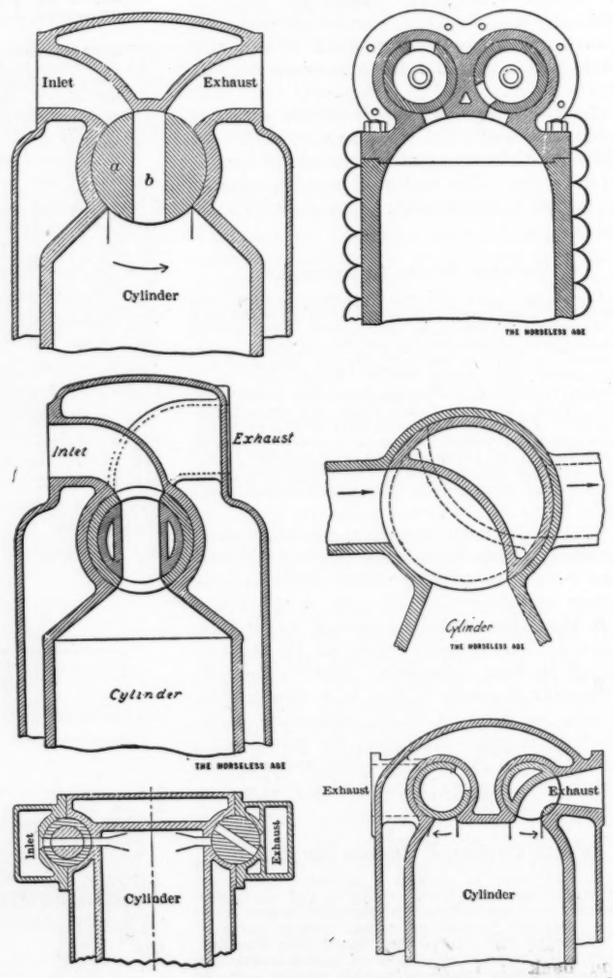
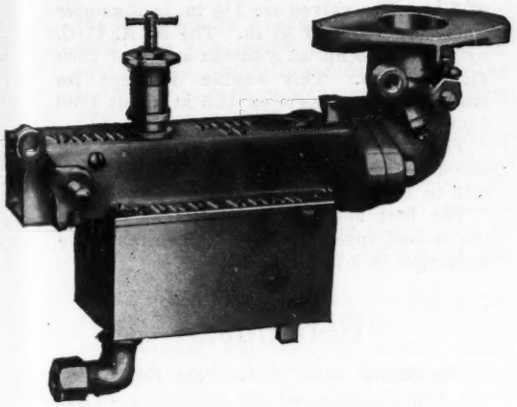


Fig. 5—Forms of rotary valves: Top, left to right, simple barrel type rotary valve; cylindrical rotary valve serving as passage; center, quarter-speed valve, one element rotating within the other; single valve with separate inlet and exhaust channels; bottom, double inlet valve; inlet valve serving as gas passage



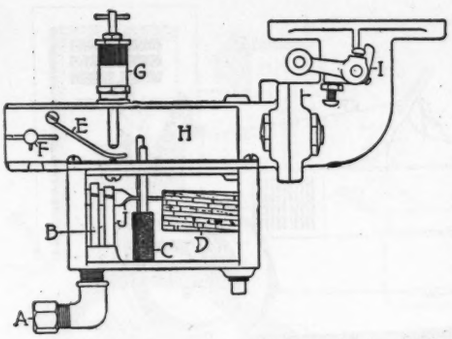


Fig. 6—Two views of Sunderman carbureter, showing, A, fuel inlet; B, float valve; C, fuel nozzle; D, float; E, air damper; F, choker; G, damper control; H, air passage and J, float lever

lifted out of the nozzle and enriches the mixture. The reverse adjustment makes the mixture lean. When the engine is cold or the car has been standing for a long time, move the steering column or dash control lever toward the rich side, which lifts the needle valve out of the nozzle and enriches the mixture for starting. As the engine warms up move the lever towards the lean side to obtain the best running conditions, until the engine reaches normal temperatures. For best economy and power the slow-speed adjustment should be as lean as possible.

If the engine does not fire properly turn the valve cap A until it does so at low speeds. Then advance the spark three-quarters of the way on the quadrant. If the engine backfires on quick acceleration of the throttle turn up the adjusting screw F, which increases the tension on the air-valve spring, until acceleration is satisfactory.

Sunderman Carbureter Explained

Q.—Explain and illustrate Sunderman vacuum carbureter.—Floyd H. Fulmer, Mishawaka, Ind.

The new Sunderman carbureter is shown in Fig. 6. In principle is is similar to the previous model, the chief change being that the tank now is located underneath instead of at the side of the instrument. The new construction is designed to give a longer sucking distance, with consequent better vaporization, and as it gives greater depth, there is less chance of the well being sucked dry momentarily when the car is tipped while rounding a turn or climbing hills.

In operation the suction of the cylinders causes fuel to be drawn from the nozzles C, which is vaporized by air entering through the air opening and controlled by E. The amount of air coming in contact with the fuel is regulated by G. This is the only adjustment on the carbureter.

Engine Leaks Gasoline

Q.—I have a Mitchell 1916 model. When I commence starting and running it, the gasoline floods the engine and sometimes it runs out of the muffler. I had a new Rayfield carbureter installed, but it did not help it any. The vacuum system seems to be all right.—Alvin Siler, Palouse, Wash.

This trouble may be due to the gasoline not vaporizing and consequently running down the walls of the intake manifold and back into the carbureter. In starting the suction of the cylinders sucks the liquid fuel into the engine, and while some of this might be fired, other portions will

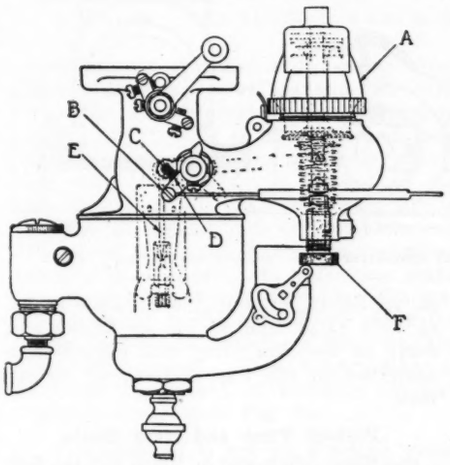


Fig. 7—Schebler model R carbureter, showing where adjustments are made

be forced out of the exhaust valves and into the muffler. You also may be running on a weak spark or one that is not hot enough to ignite all the mixture, and some of it may condense and run back to the carbureter. If you are sure that ignition, valves, carbureter, etc., are in proper order you reasonably may suspect the vacuum tank is not functioning properly.

If faulty feed traced to the vacuum tank, then look for a hole in the float, which should be air-tight. If this is the case the float becomes too heavy and will not rise sufficiently to close the vacuum valve. This allows gasoline to be drawn into the intake manifold, which in turn will choke down the engine or at least cause gasoline to flood the carbureter. To repair float proceed as follows:

Remove top of tank, being careful not to destroy the gasket. Remove float and dip it into a pan of hot water to find out where the leak is. Bubbles will rise at the point of leakage. Mark this spot. Next punch two small holes, one in the top and the other in the bottom of the float, to permit discharge of the gasoline. Then solder up the holes and the leak. Test the float again in hot water; if no bubbles rise the float is air-tight. In soldering the float be careful not to use more solder than necessary. Too much solder makes the float too heavy.

In taking out the float be careful not to bend the float guide rod. If you bend the rod it strikes against the guide and retards the float, producing the same effect as a leaky float and allowing gasoline to enter the intake manifold. Also note whether the surface of the rod is perfectly smooth so that it cannot be retarded by the guide.

Engine Runs Irregularly

Q.—I have a Dodge Brothers 1915 car, which does not run well except when pulling hard. When throttled down and running idle it lopes, sometimes almost stopping and then speeding up for a few seconds. Yet it hits perfectly, even when pulling, until car attains a speed that the engine pulls easily, when it will miss. Opening the throttle will stop the miss, until the car again attains the speed that the throttle opening will give, when the missing commences again. At its limit of speed it misses regularly. I have examined it for air leaks and have had new valve stem guide bushings fitted.—Charles E. Wilson, Sharpsville, Ind.

This is probably due to improper adjustment of the carbureter. The adjustment can be altered by changing the position of the bellcrank on the choker valve at the carbureter, which also controls the metering pin. Loosen the bellcrank from the choker shaft and change the position of the worm and gear operating the metering pin until the engine idles well and picks up under open throttle without missing. Also see that the engine has even compression and that the spark plug gaps are set $\frac{1}{32}$ in. Then set the ignition breaker points in accordance with the gage supplied with the tool equipment. The points should be smooth on their contact faces and meet squarely.

His Cadillac Misses Badly

Q.—I have a 1913 Cadillac which misses badly on the pick up or at high speeds. It runs all right on a good road, at a speed of from 15 to 20 m.p.h. It does not overheat. It is apparently, to me, carbureter trouble, but I recently installed a new carbureter, complete set of valve guides and have made certain that there are no manifold leaks. Have had the engine torn down three times within the last two years for carbon trouble, but there was no excess of carbon. The carbureter gives best results when wide open, admitting all the air possible. I recently removed a $\frac{5}{8}$-in. plug from the intake manifold, admitting still more air. The engine ran much better for the remainder of the trip but since the removal of the plug has done no good. I do not believe there is any trouble in the insulation of the condenser or coil. The missing is accompanied with knocking on a hard pull. The engine runs very well until thoroughly warmed up.—J. R. Stewart, Lawrence, Kan.

Perhaps it would be best to adjust the carbureter before trying anything else, as it seems that this might be your trouble. First set the low-speed adjustment so that the engine idles well when it is warm. Then adjust the high-speed so that the engine will backfire through the carbureter when the throttle is thrown open. This will insure a lean mixture and prevent the engine from loading up with an excess amount of gas. If the engine still persists in loading up and missing when it is opened up, then examine the cams on the lifting needle and see that they are not worn so that in certain spots of the cam travel the needle adjustment is destroyed.

If you are having condenser trouble this can be determined by wiping the breaker points clean and if after running a short time the breaker points become black, this is a sign that the condenser is broken down. This also will be noticed by a red flame from the secondary instead of a blue flame. Set the spark plugs at $\frac{1}{32}$ in. and the breaker points at the thickness of the gage which is supplied with the tool equipment of the car.

It might be well to say that this trouble

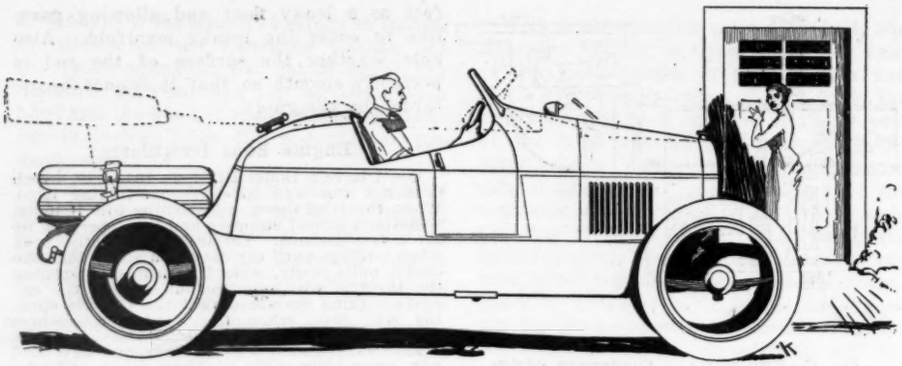


Fig. 8—Suggestion for reconstructing 1912 Apperson touring car into speedster

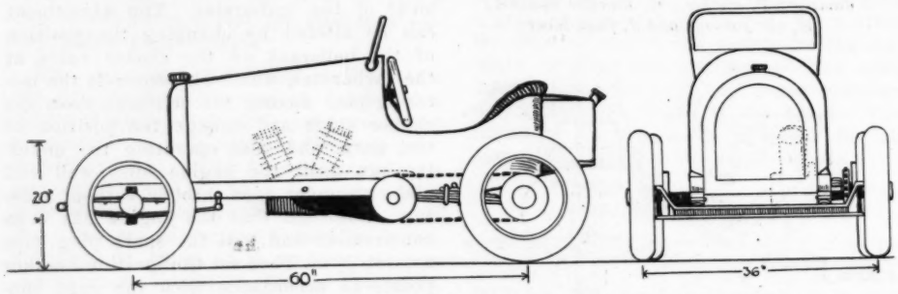


Fig. 9—Suggestion for building light speedster with motorcycle engine

is likely to occur if the engine is being run at too cold an operating temperature. Some form of radiator cover will prove whether or not you are running your engine too cold. This will also be noticed by poor fuel mileage.

Miscellaneous

Attaching Boyce Moto-Meter

Q.—How can a Boyce Moto-Meter be attached to an Overland radiator cap?—Floyd H. Fulmer, Mishawaka, Ind.

The construction of the radiator cap on the Overland makes it almost impossible to install a Moto-Meter. Perhaps some of our readers have overcome this difficulty in some manner and can suggest a method.

Race Car with No Differential

Q.—Has there ever been an A. A. A. race won by a car using an M & S or some form of ratchet differential, or no differential at all?

2—How would an M & S differential behave in a car of about 25,000 lb. at 30 to 50 m.p.h.?

3—What cars use a Duesenberg engine as stock equipment?

4—How does it differ from the Duesenberg airplane engine and what power does it develop?

5—Give specifications and description of car using this engine.—C. L. Davidson, Bell Buckle, Tenn.

1—The Marmon Wasp which won the 1911 500-mile race at Indianapolis did not have the ordinary form of differential, but made use of a ratchet construction at the wheels as a substitute.

2—There is no reason why this type of differential should act any differently from that of the ordinary type when driving on a road at these speeds.

3, 4, 5—The Duesenberg engine is standard equipment on the Roamer, Wolverine, Biddle and Revere. The motor car engine has the same characteristics as the racing and aircraft engines, except that it is heavier in construction. The four-cylinder engine weighs 490 lb. It has a bore of $3\frac{3}{4}$ and a stroke of 6 in. These engine dimensions place it within the 300 cu. in. limits. The engine develops 35 hp. at 1000 r.p.m. and 80 hp. at 2100 r.p.m. Some of the cars using this engine were described in the Jan. 3 issue of MOTOR AGE.

Fastest Time and Gear Ratio

Q.—When, where and by whom was the fastest time ever made by a motor car at any distance?

2—What was the bore and stroke of the Model 37 Buick, also, size of valves, lift of valves, S. A. E. horsepower rating and maximum motor speeds?

3—What is the standard rear axle and gearset ratios of the model 37 Buick?

4—What are the gearset ratios of the Buick D-45?—Ray Baker, Sheridan, Wyo.

Burman made the fastest official time at Daytona, Fla., April 18, 1911. The time for 1 mile was 25.4 sec., or 141.73 m.p.h.

This car has a bore of $3\frac{3}{4}$ in. and stroke of 5 in. The valves are $1\frac{1}{2}$ in. in diameter and have a lift of $\frac{3}{32}$ in. The N. A. C. C. rating is 22.5 hp. at a piston speed of 1000 ft. per min. This engine develops its maximum horsepower of 42.5 at about 1800 r.p.m.

The rear axle ratio is 3.53 to 1. The second speed reduction in the gearset is 2.23 to 1 and the first speed, 3.36 to 1.

The first speed reduction is 3.36 to 1; the second speed, 1.625 to 1. The rear axle reduction is 3.78 to 1.

Rebuilding

Speedster with Motorcycle Engine

Q.—Give suggestions and diagrams for making a light speedster body to fit a twin-cylinder Harley-Davidson motorcycle engine.—John B. Berloglio, Twin Bridges, Mont.

In Fig. 9 is shown a suggestion for constructing a small lightweight speedster, using a Harley-Davidson motorcycle engine. The car is equipped with airplane wheels and final drive to rear axle is by roller chain. Have plenty of air coming to the engine and if necessary you can fit baffle plates on the inside of the body to deflect the hot air from your body.

Wants Ford for Racing

Q.—I am stripping a Ford car for a racer. Would a sixteen-valve cylinder head give more speed than the original valves?

2—Would boring holes in the piston rods lighten them; also in the connecting rods?

3—Would a counterbalanced crankshaft give more flexibility?

4—Would it be possible to set the camshaft ahead so it would open the valves earlier, yet not interfere with the power? If so, how?—H. Johnson, Warren, Wyo.

1—So long as you are looking for speed we should advise the sixteen-valve head. Two inlet and two exhaust valves per cylinder are better than one of each per cylinder for fast work. It allows the incoming gases a better chance to get into the cylinder and likewise expels the exhaust gases more quickly, preventing overheating. Inasmuch as the valves are only $1\frac{1}{4}$ in. in diameter, as in the roof construction, they should not warp under excessive heat.

2—Yes. But be very careful in drilling

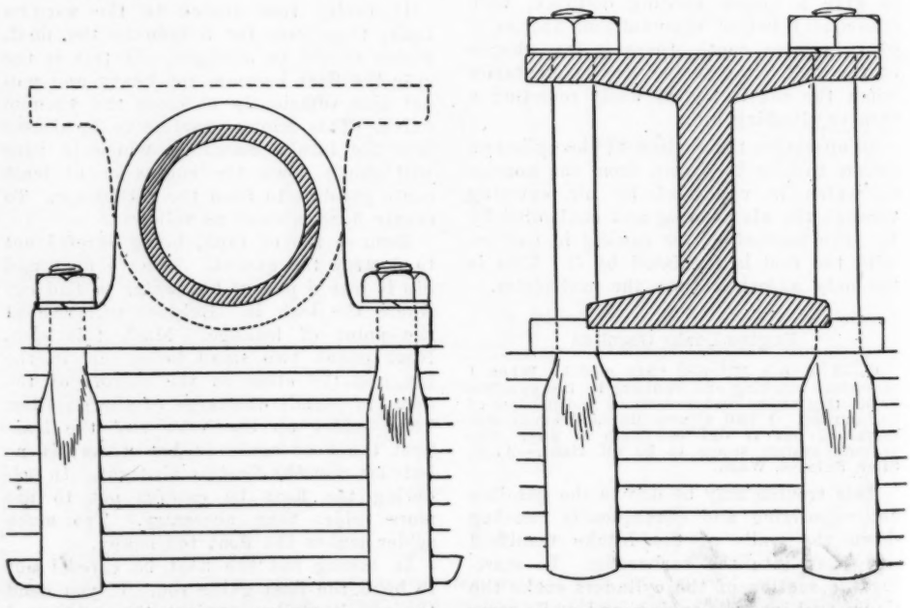


Fig. 10—Manner of lowering the front and rear springs on a 1912 Apperson to lower center of gravity of car

the holes not to weaken the parts; do not drill near the piston pin bosses, and in case of the connecting rods drill only at the upper or reciprocating end and a little over half way down the rod.

3—A counterbalanced crankshaft affords a smoother running engine and as these weights can be had at a reasonable cost, it would pay to install a set. They are easy to install and it is necessary only to remove the plate on the bottom of the crankcase.

4—If you expect to use the engine for racing only you could set the valves to open earlier, but then the engine would not run well at low or normal speeds. Also the teeth on the Ford timing gears are too coarse to permit of changing the setting of one tooth either way. It throws the valve timing too far out. An alternative would be to fit timing gears with more teeth, so a much more delicate adjustment could be made. The best plan where an owner wants speed is to install a special racing camshaft with larger carbureter and valves. It is hard to compromise on a job of this kind; you have to build either a car capable of moderate speeds or an out and out racing proposition, wherein everything has been sacrificed to get the last ounce of power.

1912 Apperson Into Speedster

Q.—Publish diagram showing how to convert a 1912 45-hp. Apperson touring car into a two- or three-passenger sporting car without fenders or running board. What suggestions could you give for lowering the front and rear springs? Would you advise windshield? What carbureter would you advise, as the original Stromberg loads up on low speed? Would you advise aluminum pistons? What speed could this car make?—Charles Hughes, Victoria, B. C.

A suggestion of this car converted into a speedster is shown in Fig. 8. The dotted lines show the old body. Note that the steering wheel has been lowered. To lower the springs see if you cannot undersling them from the axles. You can hardly expect to change the shape of the springs themselves so they will lie flatter, but sometimes it is possible to swing them under the axles. Perhaps you can turn the rear spring perches around so they are on the bottom of the axle and then bolt the springs in place, using the clamping plate on the bottom instead of the top of the spring. The front axle spring perches are probably in unit with the top flange of the axle, hence their position cannot be changed. In this case make heavy metal plates of the same size and shape as the spring seats to fit under the latter on the axle, cutting a notch so they will fit properly. This construction as well as the method of lowering the rear springs is shown in Fig. 10.

A windshield is not an absolute necessity, but you will find one very handy. It will not offer much resistance if built as shown in Fig. 8. The best thing for you to do in the carburetion proposition is to substitute the latest make of the carbureter you have. The old instruments will not handle present day fuel properly. Any of the modern makes will be satisfactory, but get it large enough if you want speed and power.

Aluminum pistons should be satisfactory for this car. Send one of the old ones to any of the piston makers advertised in MOTOR AGE. You will then be sure to get the proper sized aluminum.

It is impossible to state the speed possibilities of a reconstructed car, because so much is dependent upon the amount of work done. Many factors have to be considered—gear ratio, tire size, engine revolutions, carbureter size, etc. Should you succeed in getting the engine to turn over, say, 1490 r.p.m., the car would travel about 50 m.p.h., with 34 by 4-in. tires and a gear ratio of 3 to 1.

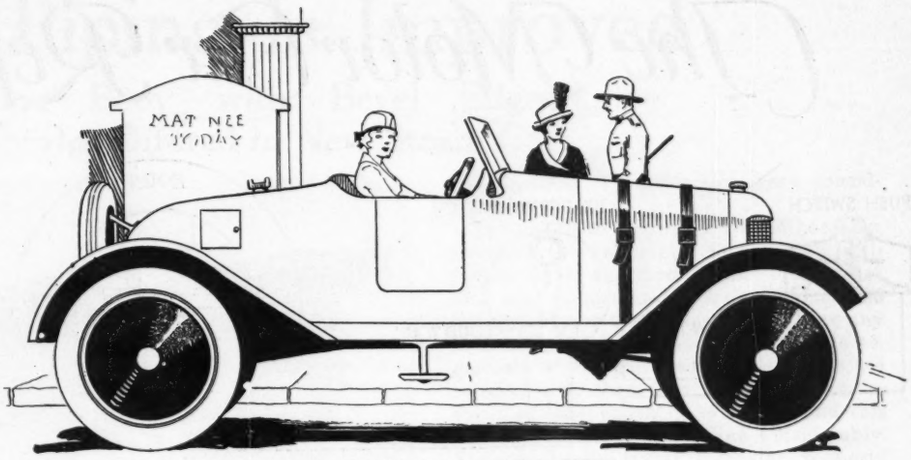


Fig. 11—Reader's idea as to a Ford built into a speedster

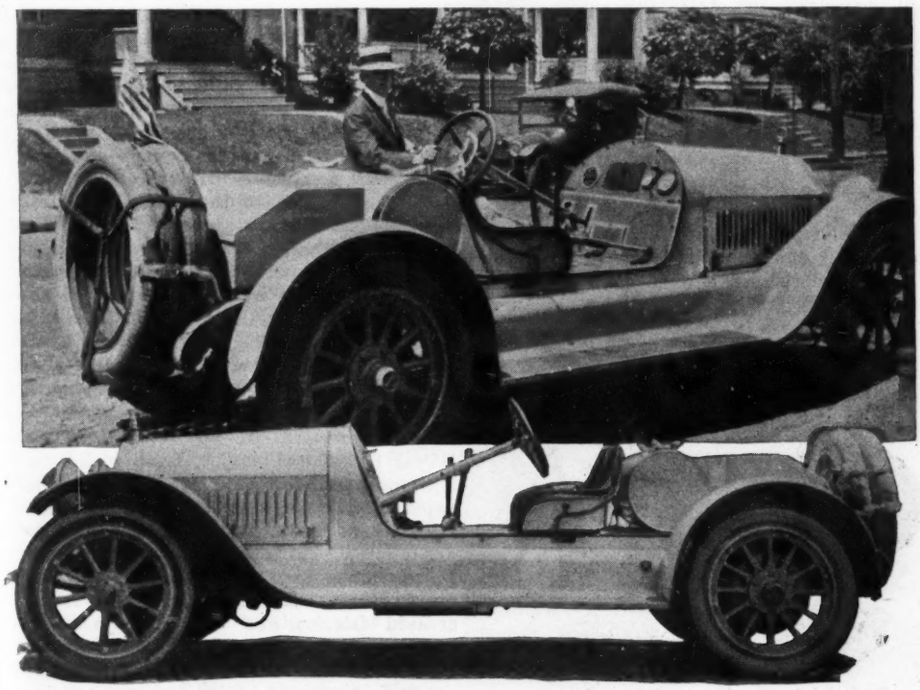


Fig. 12—Two views of roadster rebuilt according to ideas of Motor Age Reader

Reader Suggests Rebuilt Ford

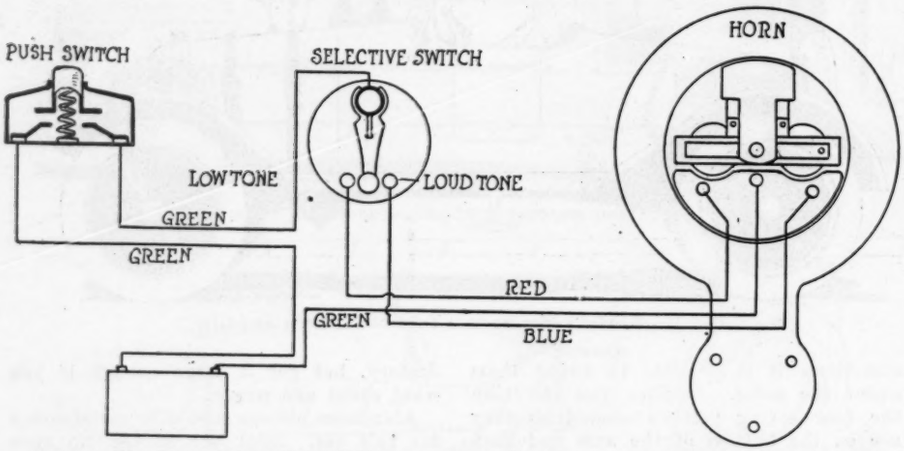
Regina, Sask., Editor MOTOR AGE—I am sending you an illustration of a remodeled Ford and for the benefit of readers who might be interested in rebuilding such a car would say that the first step, or first consideration, in such work is the engine. I consider the Roof sixteen-valve engine head the most suitable for remodeled Fords. The camshaft should be of the high-speed type; a splash oil system is better than gravity and the Atwater Kent ignition system is a very good one. The Ford carbureter is sufficient for such a car; the gear ratio can be changed also.

The next step to consider is the body. The frame should be lengthened and the axles lowered. The ordinary Ford radiator can be used, but I believe a pointed one is better. The Moto-Meter adds to the appearance of the car. A small top can be carried and the windshield taken off; fenders and running boards should be left off.—Leonard L. Smallwood.

Reader Has Rebuilt Moon

Cincinnati, Ohio, Editor Motor Age—There have been many interesting and attractive articles and illustrations of roadsters of unusual types in late issues of MOTOR AGE. However, I haven't seen just what I believe would suit me. Am inclosing two photos of my roadster, which, when I had it built, I thought was all that could be desired, but since then styles have changed, though I still think I have the most attractive roadster in town. The car is a special built by the Moon Motor Car Co., 1916-50 chassis and powerplant. It is painted ivory color.—Subscriber.

The Motor Car Repair Shop



Wiring diagram and installation of the Warner two-tone horn, showing the selector switch which makes possible a loud or soft tone

Installation of Warner

THE installation of the Warner two-tone horn, made by the Warner Electric Co., Muncie, Ind., is so made that either a low note or high note can be had at the will of the operator. All parts are installed permanently and require no adjustment. There are, besides the horn, two switches to put in place. One is the conventional type of horn button, to go on the steering wheel, while the other is called the selector, a two-point switch which governs the character and volume of sound emitted. When the car is standing still the selector arm may be set on center or removed entirely. Either will open the horn circuit and intruders cannot operate it. It is said that vibration has no effect on the electrical or mechanical operation of the horn.

Current is taken from the car's storage battery, or if a battery is used for ignition only, current for the horn also can be taken from it without interference. When the selector is set for the low tone the energy required for signaling is about 0.7 amp. and for loud or country signaling about 1.4 amp. A set of four dry cells used for signaling only should supply current for an entire season's motoring.

The horn is simple and necessitates one supporting post, which permits a third of the housing for the accommodation of the binding posts for attaching cable. With this arrangement all parts are protected and nothing is exposed. A hole is provided through the flange, just above the arm of the frame for passing the cable through to the connecting terminals. Twelve feet of cable is furnished with the horn. Each conductor consists of several copper wires twisted together and covered with rubber. Glazed cotton braid is knit over the rubber insulation. The conductors are made into a cable which is varnished and baked.

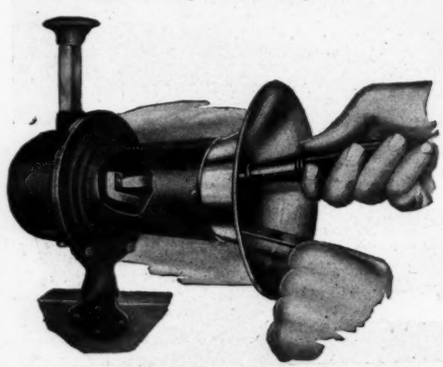
Some horns used with ignition battery, unless they are connected in a certain way, interfere with the ignition circuit at times, when the battery is recharged or a new set of dry cells installed, caused by reversing the wires connected to the battery. On the Warner the construction is such that it makes no difference which pole of the battery is connected to the horn.

The accompanying wiring diagram shows the installation which is not hard to make, inasmuch as the horn comes with some of the cables partly attached. The illustration shows the selector locked, as it should be when the car is left alone. The selector is equipped with screw terminals. This arrangement is also handy in case the wiring accidentally is damaged, for the cables may be detached quickly for test without cutting them.

Adjusting the Fitzgerald

There is nothing complicated in the way of adjusting the Fitzgerald horn, made by the Fitzgerald Mfg. Co., Torrington, Conn., and the operation is shown clearly in the illustration. The horn is operated mechanically with adjustment for sound as follows:

Hold adjusting wrench in left hand and screwdriver in right. Turn adjusting nut to right to loosen, then with the screwdriver give adjusting screw a slight turn to the left. The latter should be tightened only enough to take up the wear at its end caused by long usage. The horn should blow freely and easily with but a slight pressure on the pushrod, emitting a loud echoing sound. If the adjusting screw is clamped down too tightly the pushrod moves with difficulty and the sound emitted will be harsh and short. The best adjustment is to have the screw just tight enough to cause a good loud sound from a slight exertion of the pushrod. Having the adjusting screw too tight causes rapid wear of the parts in friction and is otherwise unsatisfactory. Oil the horn about once in every three months with some good lubricant.



Partial interior view of Fitzgerald horn, showing manner of varying the tone

Heat and Tire Pressure

Details of a series of experiments just conducted by the B. F. Goodrich Rubber Co., Akron, Ohio, to determine the effect of heat and cold on the air pressure of the pneumatic tire, the variations in temperature that ensue under certain elemental and climatic conditions, are disclosed today to eradicate once and for all an obsession among motorists that a certain amount of air should be let out of tire to make up for increased air pressure caused by heat. This is one of the most disastrous practices with which the dealer has to contend, because under-inflation loosens the tread from the fabric, giving it a wavy, rough appearance and soon fits the tire for the scrap heap. Under-inflation is really the white plague of the pneumatic tire.

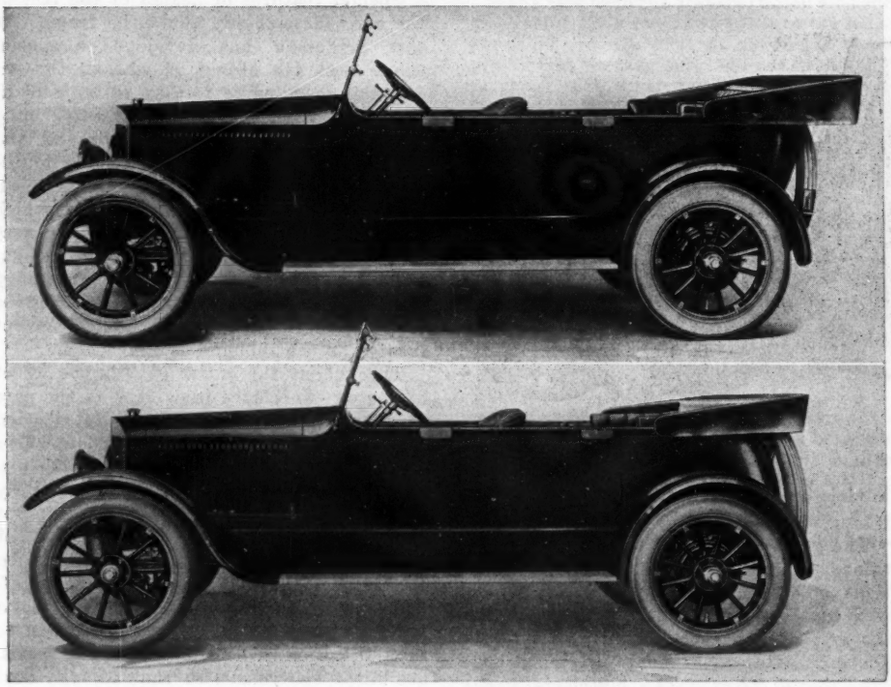
A 34 by 4-in. tire was used for the tests. The pressure prescribed by all tire manufacturers for this size is 70 lb. This was pumped into the tire at a temperature of 40 deg. Fahr. Then it was heated gradually until it rose to 110 deg. At this point the reading of the air pressure indicated 78.4 lb., or an increase of 8.4 lb. It would be a rare thing for air that was pumped into a tire at 40 deg. to rise to 110 deg. Yet, even in this extreme distance the pressure rose but 8.4 lb., which was not dangerous.

A more practical test, one within the limits of experience of the average motorist, then was conducted. Another 34 by 4 tire was pumped to the standard 70 lb., this time at a temperature of 70 deg. The tire then was driven at a rapid pace through hot sand stretches to ascertain just how much it would heat up. The average was found to be 110 deg. Then the tire was taken to the laboratory and heated to this temperature. The air pressure at this point was found to be 75.3 lb., an increase of but 5.3 lb. This is a usual condition, which results have proven is practically negligible.

Frequent observations conducted by tire experts have demonstrated that the vast majority of motorists keep their tires under-inflated. In this connection it is well to remember that air pressure is just as apt to increase in cold weather, due to increased friction and contact with sand, rocks, ice, etc. Yet the motorist never thinks of letting out air in winter. The safety-first rule is to keep your tires inflated as prescribed by the manufacturer.

Stanley Piping Is Improved

Straight-line Body with Bevel Edges Features Styles Offered in New Steam Car



Body styles offered in new Stanley, four-passenger, below, and seven-passenger

PROBABLY the most radical changes in the new Stanley steam car are in the body and the piping system. The body, a George J. Mercer design, has been changed to embody the straight lines in vogue this season. The cowl and hood have been raised, making the radiator higher. The V shape at the front of the radiator is accentuated until it has what is called the Mercedes line. In general the car is a straight-sided type with flat bevel edges, square corner on the door, full crowned fenders, cowl board for gages, speedometer, etc., and sloping windshield.

Two Body Styles

Only two body styles are offered, a seven-passenger at $2,600 and a four-passenger at $2,550. The four-passenger has both front and rear doors, and a sweep has been given to the back where it is moved to make the car close coupled, making it a modified turtle-back. Finish is Royal green. The chassis alone lists at $2,225.

From the owner's standpoint perhaps the biggest change is in the electric device for heating and igniting the pilot vaporizer. It used to be accomplished by a Prest-O-Lite tank. This has been done away with, and the current now is furnished by a Willard storage battery to a heated resistance coil controlled by a button and a dowl. The arrangement is so constructed that the current cuts itself out after its work has been accomplished. With this modification of the burner it is now possible to use kerosene in the pilot. If desired, however, gasoline also can be used, or a mixture of the two fuels. Pilot burner and vaporizer are a unit and can be removed easily at any time without disturbing the burner.

The cleaning up of the chassis is probably the most noticeable engineering improvement in this year's Stanley. By redesigning the piping system it has been possible to reduce the total length of piping about 60 per cent. The piping itself also is standardized as to size and fitting, and the units have been made much more accessible.

In the fuel line the vaporizer coil and the so-called master valve have been omitted, and the fuel line is controlled by the main burner valve on the instrument board, which not only does the work of the fuel valve but also incorporates the work of the master valve as well. The pressure tanks on the fuel system are now in front of the pump box instead of at the rear by the main fuel tank. This eliminates a complete return piping system to those tanks and shortens the connection very considerably.

The piping in the water system has been standardized as to size and is now uniformly 7/16 in. throughout. The front and rear pumps are interchangeable, and the system has been improved so that any sound, or water hammer, is impossible regardless of the car speed. The pumps are connected so that they work together instead of independently as before, and this has simplified the water line considerably. The three-tube water indicator formerly employed has been replaced by one of new design, which is magnetic in operation and always indicates the correct level of the water whether the car is under steam or not.

The piping diagram herewith shows the new system completely. It will be remembered that this is in diagramatic form and that on the car the locations of the units are somewhat different. For instance, the water tank is right beside the power pump instead of below, as indicated in the diagram. The rear by-pass valve has been eliminated, and both the rear and front water pumps are controlled automatically, and the drive need no longer use a rear by-pass valve as heretofore.

Very few changes have been made in the steam system. One important change, however, is in the super-heater, which is arranged in a series of parallel loops instead of a coil as heretofore, and the steam on leaving the super-heater goes direct to the engine instead of passing up through the boiler. This arrangement gives improved accessibility.

The fuel system has been simplified by moving the pressure tank up to the pump. This places the units in the most direct arrangement, and the air pump line to the pressure tank is only 18 in. long instead of being the entire length of the chassis. The fuel automatic is under the floor in the rear so that the return line from the automatic can be very short. The fuel pump is practically unchanged, and the fuel passes straight to the burner, taking the fuel automatic, pressure tanks, low-water automatic and steam automatic on the way. It enters the rear end of the boiler and passes to the burner. The pilot

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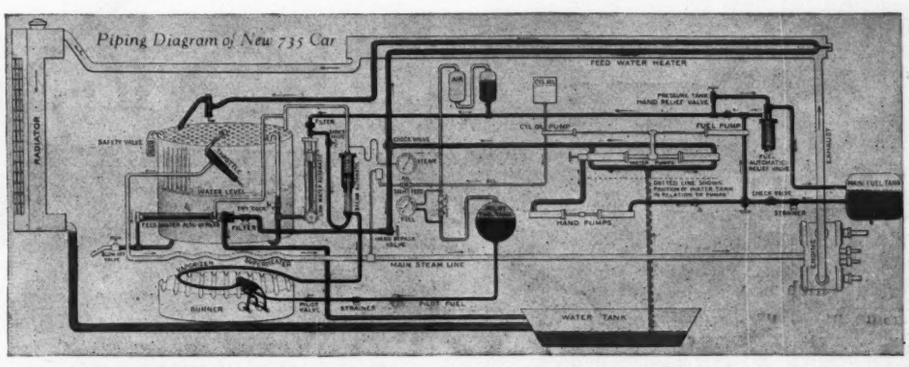
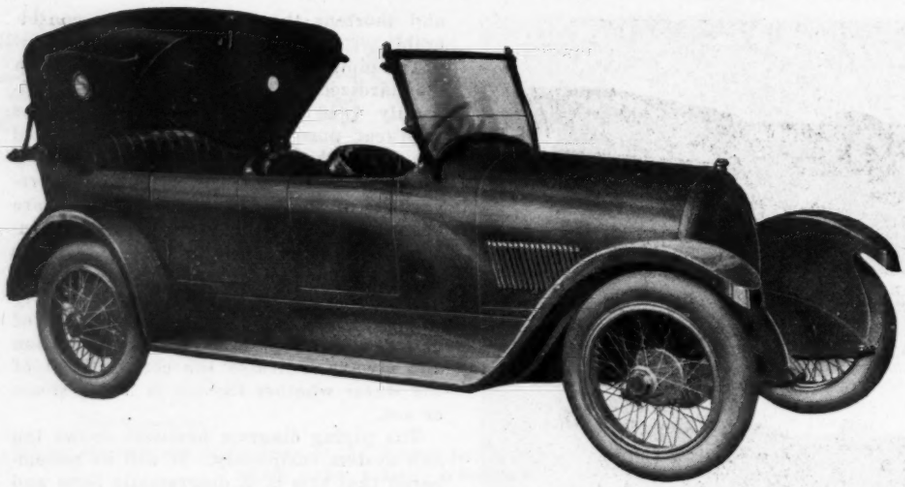


Piping diagram of new Stanley car, showing the simplified connections

Revere Car Is Product of Racer

Designs Embody Speed for Fast Road Work



One of the three Revere models on the market

AS is to be expected of a car whose design is the product of three men for years identified with racing, the new Revere car has many earmarks of the speedways. It is the product of the Revere Motor Car Corp., Chicago, which as has been announced previously in these columns, has its factory at Logansport, Ind. It is the design of Gil Anderson, who piloted the Stutz in many of its victorious speed contests and who is now the chief engineer of the Revere concern. Tom Rooney, also a former Stutz pilot, and Adolph Monsen assisted in the production of the new design.

As offered to the market, the Revere is constructed for fast road work and looks it even in the touring types. It appears to date as a speedster, a four-passenger sport model and a six-passenger touring car; the price varies from $3,500 to $3,800, depending on the style. It is featured by a 4⅜ by 6 four-cylinder Duesenberg racing-type engine, a special shape of frame and spring suspension which is Anderson's own design.

The general status of the car can be obtained from the following brief specifications. These include a four-speed gearset with direct on high in unit with the engine, the drive taken through universals to the floating axle with final drive through spiral-bevel gears. The clutch is a dry disk with fabric facing. The torque is taken up through two rods, one on either side of the propeller shaft. The wheelbase is 130 in., tires 32 by 4½, Goodyear cords on wood or wire wheels.

Equipment includes Bosch magneto, Bijur electric system, Miller or Stromberg carbureter and Hartford shock absorbers.

It is unnecessary to go deeply into the detail of the Duesenberg engine, except to say that as supplied in the Revere it has the same features of design that has made it successful on the track. Readers are familiar with the essential feature of this engine, which consists of placing the valves horizontally in the heads and operating them by vertical walking beams. With this engine the Revere people claim a speed of 85 m.p.h.

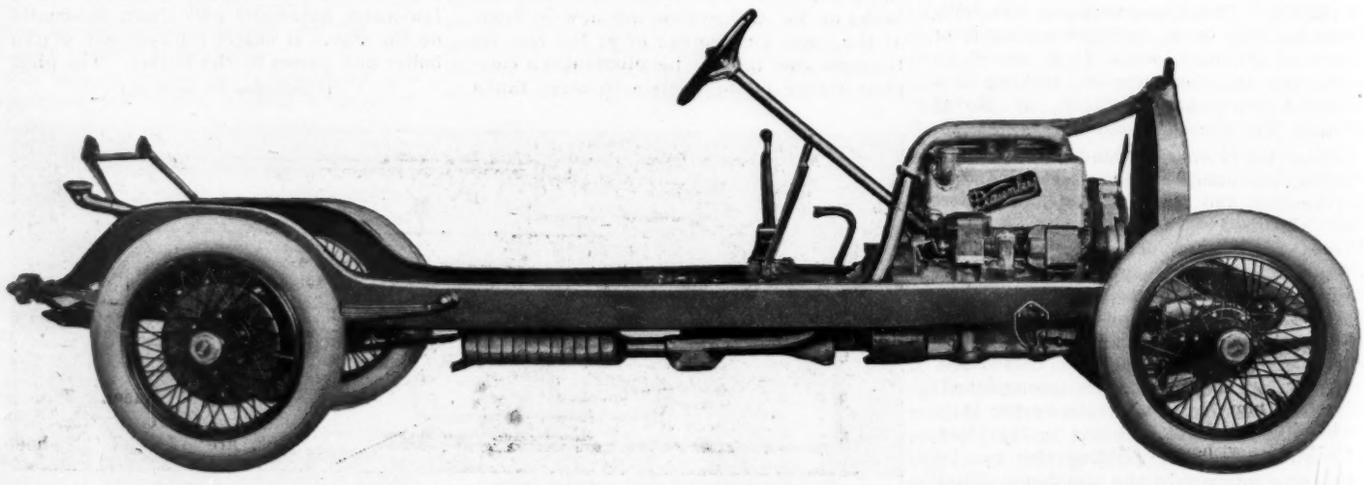
Special features of design of the rest of the car center chiefly about the frame. In this Anderson has developed a special shape with the object of making the car hug the road, make it easy riding and at the same time have it low enough hung for giving both speedy appearance and safety. The frame members have a double kickup, one over each axle. This is indicated in the side view of the chassis, which shows the exceptional height of the rear kickup. The front springs are conventional but the rear spring is a special design which, while semi-elliptic in form, gives the cantilever effect, it is claimed, except insofar as the rebound is concerned.

Throughout the entire chassis the effect of racing experience is evident in the care to provide easy and adequate lubrication and also to relieve bearing friction where possible. The former is shown in the disposal of the grease cups, which not only are in evidence at every moving part but are so placed that they are very easy of attention. Such means as ballbearings on the gearset shafts and so on indicate efforts to cut down friction. There is a special stud made a part of the frame to take the Hartford shock absorbers, which are stock equipment, so that for the first time in American practice the shock absorber becomes really a part of the chassis and not an afterthought.

Brake Adjustment

One of the special features to be appreciated is the brake adjustment which is accomplished by means of a small hand wheel made accessible by lifting a floor board.

Naturally, it is not expected in a car of this type to attempt quantity production, and consequently the matter of body styles will be dictated to a large extent by the taste of the purchaser. There will be additional styles to those mentioned above. The bodies produced so far have racy and somewhat European lines, the radiator giving a front view of the car quite a Fiat cast of countenance. The body lines from



Looking at the chassis from the right. It is featured by a special frame and spring suspension

the radiator back include a high sloping hood with a sharp drop from the cowl to the rather lower side panel ending, in the sport models, in a streamline-effect rear deck which provides carrying space for luggage.

Design and Transportation

(*Continued from page 23*)

remote, have become our next door neighbors. This great change has been accompanied by a revulsion of feeling in this country which would have been considered impossible.

A great national wave of economy has swept over the country. Our great National fault has been extravagance. We have been extravagant of every resource. The great forests which once covered the country with timber have been cut away so that to-day lumber is cheaper in the oldest countries of the world than it is here. Our minerals, the game from the fields and forests, all the gifts that nature bestowed on this country, have been used with an unsparing hand and naturally along with this the habits of our people have been molded until we have been known as the most wasteful nation in the world.

It is but natural that this molding of our nature should express itself in the tools we use. To bring this down to the point in which we are all interested it is shown quite clearly in our automobiles. The American people have been buying cars by size. They have been buying cars by the pound. Two cars placed side by side, each costing the same price, but one being larger and more gaudy appearing than the other, would not compete with one another, as the larger one would have nearly all the sale in spite of the fact that the other may be a better piece of engineering from one end to the other. But a change has come.

More Efficiency Needed

We have awakened suddenly to the fact that the automobile of to-day is not efficient and not economical and at the same time the people of the country have been awakened by the exigencies of war to the fact that our daily habits, whether they are concerned with transportation or what not, must be more efficient and economical.

These words may seem like generalities and generalities are wasteful of time and thought unless we can turn them into something constructive. Happily it is impossible to fail to see the constructive possibilities of increased transportation efficiency if we only apply the lessons which are coming to hand every day. The meaning of transportation, the act of carrying from one place to another, is clear. The meaning of efficiency is also clear to any engineer. It is simply output in terms of input. If a machine is 80 per cent efficient, its output is 80 per cent of its input, whether measured in terms of heat, distance, dollars or any other of our standards of measurement.

When we say the automobiles of to-day are inefficient, and are not returning to the owner the value in transportation that they ought for the money expended, we simply mean that what he gets back in transportation is not enough in proportion to what he puts in.

Take for instance the man who owns a car weighing 2½ tons who drives downtown to his office, a distance of 5 miles. In the evening he returns, another 5 miles. If a friend were to offer to take him to his office and back for a dollar a day, he probably would laugh at him. Yet in all probabilities this is what it is costing him. The upkeep of such a car, even without including the depreciation which we all know is high in a car of this weight, easily will amount to 10 cents a mile.

The car weighs too much for the passenger load. The man weighs probably 150 lb. The car weighs 5000 lb. In other words, 33 lb. for every pound of passenger weight. This is too much. The car is heavier than the average it is true, but this example is taken merely to illustrate the point. Even with five passengers in the car, the weight would be over 6 lb. per passenger and this is too much.

Study this from the transportation efficiency standpoint. We have two sides to the ledger sheet, on one side what we put in and on the other what we take out. We put in money in terms of fuel, time, weight of vehicle, labor, if a driver is employed, road or track maintenance and vehicle maintenance. We take out just two things, passenger-miles and comfort. The comfort comes extra on an automobile as it does on a Pullman car. In a commercial vehicle it is ton-miles alone.

Most of the cost factors are in the control of the engineer and, indeed, most of them are simply weight factors. Taking them one by one:

Fuel Consumption.—Primarily affected by weight and to a moderate extent by design in average practice.

Time—Controlled by law and traffic conditions.

Weight of Vehicle—The real crucial factor involving displacement and weight of powerplant, length of wheelbase, physical qualities of materials, vehicle characteristics and purposes.

Road or Track Maintenance—Covered by state tax and a function of weight and horsepower in many states.

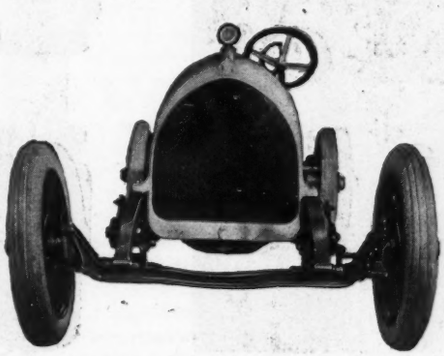
Vehicle Maintenance—Factor of weight, materials, design, handling, road conditions and a number of other variables.

In every one of these items we have been high in the past and we must make a rapid change to reduce them if we wish to fit in with the desires of the public. If the progress of the times is to be studied, it must be done with the broad fundamentals outlined carefully in mind.

The new cars at the shows are hardly wartime cars. They have been out on the road under test for so long that they antedate the economy wave which has swept over the country. All that they serve to show is that the tendency was in the direction of what has now come to be a demand. This demand in a great many ways is not even known to the people themselves, yet it is there. The attitude of the people at the shows was to a large extent noticeable. They were searching for something they did not find and so they took the nearest thing to it, or took nothing at all.

These people were looking for a car in which the weight per passenger was at the lowest limit. In other words, a car that utilized every inch of wheelbase to the greatest possible efficiency. That was not of a displacement higher than necessary to carry the load; that had materials which returned the greatest amount of service because of their light weight and scientific disposition.

No longer were they looking for the biggest car that they could buy for a certain sum of money. The American public have had a psychological shock from which it has not recovered. It is to be hoped that it will not recover because the new condition is a healthy one begetting a higher plane of mental and physical existence. It is up to the automotive industry to design tools which suit this new state of mind.



How Revere looks from front

At this time of the year when all the new cars have made their appearance and the designs for the following season have all been disclosed we naturally are interested in seeing the trends of development. This year, for the reasons pointed out, the trends cannot possibly teach us as much as in the past, because the designs in which they are included cannot possibly have taken into consideration the change of the national psychology. Nevertheless, since we were beginning to move in the right direction it is important to study these developments to see what should be accelerated to meet the new conditions and new standards. We must hold up the past tendencies; in other words, to the spotlight, and see what conforms to our new demands for conservation and economy.

Five at Show New

At the shows there were but five really new chassis, incorporating new powerplants and redesigned to a sufficient extent to really classify them as being absolutely new. During the year two additional chassis which can really be classified as new were brought out. This gives a total of seven entirely new chassis which were not on market a year ago. All of these have new powerplants and are the latest types under normal development. It is interesting to note that of the seven, five are four-cylinder and five have overhead valves.

Nothing radical is to be noted in any of these cars except that the leaning toward overhead valve is becoming stronger year by year. The conclusion cannot but be made but that an unqualified indorsement has been placed upon the overhead engine by the industry. The fundamental reason behind this development is naturally the effort to secure the greatest possible output from any given displacement. Volumetric efficiency with the lowest possible losses through wall cooling naturally would tend to favor construction. Here it is possible to use the most direct entrance into the combustion chamber and at the same time secure the most advantageous combustion chamber shape.

Stanley Piping Improved

(*Concluded from page 41*)

fuel system has become one straight tube from the pilot tank to the pilot burner, without interruption and with only one valve. A loop in the pilot line directly over the pilot burner acts as a small vaporizer.

The boiler is a Stanley fire-tube type of welded construction, 23 in. in diameter. The burner is a drilled type, and pilot and burner use either kerosene or gasoline, the pilot having a small tank of 4 gal. capacity. The engine is a two-cylinder, 4 by 5, slide-valve type, double acting. The wheelbase is 130 in.

The water tank holds 24 gal. and has a mileage of from 170 to 250. The pump is driven from the rear axle at a quarter piston speed. The fuel tank holds 20 gal. Lighting is by Willard battery and Apelco generator. Steering gear is Warner. The brakes are on the rear wheel. Timken front axles and Stanley rear axles, with Timken bearings, are used. The wheels are 34 by 4, and 35 by 4½ straight-sided tire are fitted. The body is aluminum.

The Accessory Corner

Gemco Transmission Bands

GEMCO quick-detachable transmission bands require 30 min. for installation, whereas the old way requires 5 hr., it is claimed. The bands are sold usually in sets of four, one as extra for quick roadside changes. The old bands can be relined at little expense so that by buying a set of four the driver always has one extra, newly-lined band for emergency. Price, $1.70 each.—Gemco Mfg. Co., Milwaukee, Wis.

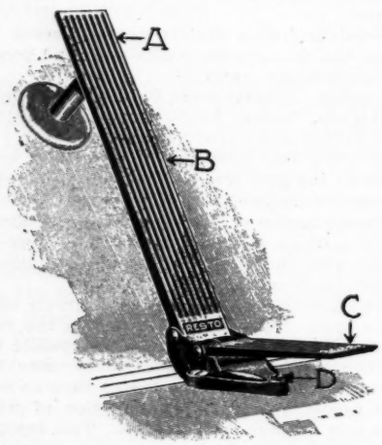
Swivel Repair Link

The One-Minute swivel repair link is made of high-grade malleable iron in three parts. Sizes suitable for all sizes and patterns of weldless wire chain are made. A hammer or pliers are the only tools required for installation. To attach, fit the chain to the eyes, place the flanged ends of the eyes in the collar and give a few taps with a hammer or a squeeze in a vise, and the swivel link is complete. Prices, 85 cents to $1.15 a dozen, according to size.—Cleveland Galvanizing Works Co., Cleveland, Ohio.

Electrically-Operated Doors

The Electromatic electrically-operated door hardware is designed to enable the car driver to open or close the garage merely by pressing a button. The hardware can be installed on any opening where head room is 12 in. or more. The mechanism is controlled by two push buttons placed where desired. Pressing the opening button turns on lights, unlocks doors and folds them back clear of the opening. Pressing the closing button reverses the operation. Pressing initial button stops the doors instantly. The buttons, when placed outside of the building, can be operated with a cylinder lock. In cases of emergency, power off, etc., a slight pull of a lever disengages gears and the doors can be operated by hand. The doors are connected mechanically, so opening one section opens the other. Provision is made through a spring-checking device to prevent accidents to persons or cars in the opening after starting switch has been thrown. The hardware is of highest grade steel and malleable iron, motor driven through worm gears to operating shaft. The parts are assembled complete with standard motor on a heavy plank for shipment, and the plank can be used as a template for installation.—Allith-Prouty Co., Danville, Ill.

Prismolite patriotic radiator emblem



Resto accelerater foot rest

Patriotic Emblem

One permanent flag attachment for the radiator cap consists of whirling flags arranged on the principle according to which school children fashion windmills out of paper, and presents a bright, attractive means of indicating patriotism through an emblem. The device is furnished complete with small attachment. Price, $1.—Prismolite Co., Columbus, Ohio.

S & S Shock Absorber

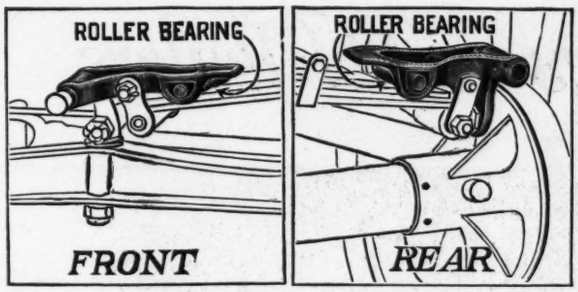
The S & S is a springless shock absorber fitted with roller bearings and designed to adjust the weight to the spring absorbing the shocks by flexing the end of the spring. It is constructed of specially annealed malleable iron with a finish of dipped and baked enamel. Installation is simple. The same shackles that are used on the Ford spring will install the device. Price, $4 a pair.—Starkweather-Snook Corp., Fort Madison, Iowa.

Spark Plug Head

The Hildebrand spark plug is a device designed to enable the car owner or repairer to determine through a glass dome fitted on the spark plug the working of the plug in the cylinder at the point of ignition. A metal collar fitted to a corresponding disk of insulating material is mounted

Electromatic electrically-operated doors, operated from buttons on post

Hildebrand spark plug head, left, and Boe oil pump



Above—Foster repair creeper fitted with pillow and pad for garages

Left—Front and rear views of the S & S springless shock absorber

on top of the spark plug, tightly shouldered against the porcelain insulator and fashioned in such a manner that a circular trench is formed around the top screw of the spark plug. This trench acts as a spark gap and is surmounted by a protecting glass dome through which sparks can be seen jumping across the gap to the electrode leading to the business end of the spark plug in the cylinder. The device was invented by Richard E. Hildebrand of the Red Cross Filter Co., Chicago, now in the Navy.

Garage Repair Creeper

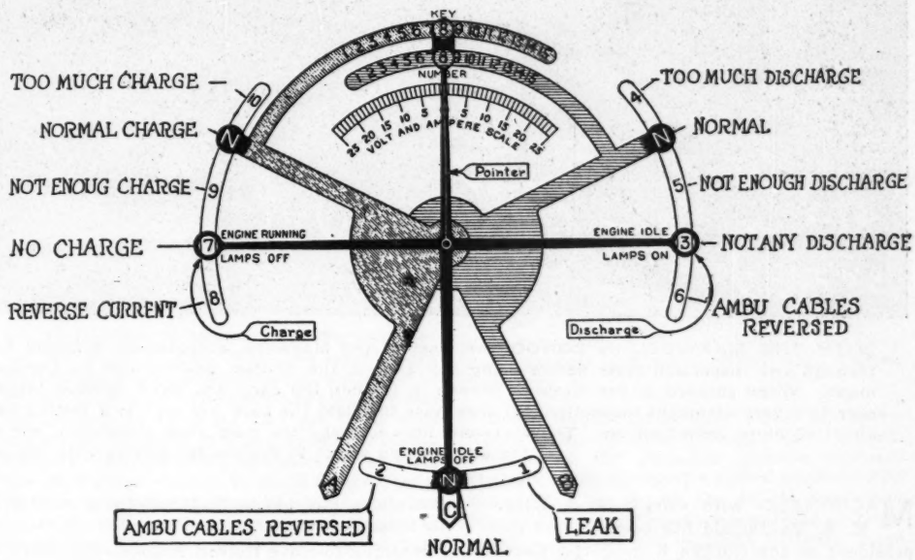
The Foster repair creeper is metallic throughout. It is made with a strong angle iron frame and high-grade link fabric spring suspended in the center, covered with a full-length cushion and headrest. A small parts holder movable and of cast iron is provided with each creeper. This can be hung in any position on the side rails for holding nuts, cotter pins and other small parts, making working under the car doubly convenient. Price, with pillow only, $3; with pillow and pad, $4.25. —Foster Bros. Mfg. Co., Utica, N. Y.

Automatic Oil Pump

The Boe automatic oil pump dispenses and measures oil directly from the original barrel into the oiling system of motor cars simply by the opening of a shut-off valve. It is designed to make any barrel a portable self-measuring tank and fits any style of 25 to 60 gal. steel or wood barrel. Attachment is in a few minutes, and measuring is graduated to ¼ pt. There are no moving parts and no funnels. Adjustable steel plates protect the barrel heads. Air pressure is applied through the discharge pipe, and the contents are measured automatically as dispensed from small tank to point of use. An extra-heavy truck is supplied with 30 by 7 in. steel tank. Weight for shipping is about 100 lb. Price, $30.—H. M. Boe Co., 2416 University avenue, Minneapolis, Minn.

Accelerater Foot Rest

The Resto accelerater foot rest permits the driver to shift his foot at will by providing more than one place at which the foot can rest to accelerate the car. A variation in position of more than 8 in. is given. Referring to the illustration, adjustment screw D is used with Resto in extended position to maintain a uniform speed. A, B and C indicate three of the positions where foot can rest to accelerate the car. The adjustment screw can be eliminated if desired.—Bloom Auto Specialty Co., Tiffin, Ohio.



Construction of Ambu trouble locator, which is used in testing

Construction of Ambu Trouble Locater

THE Ambu instrument is fundamentally a combination volt and ammeter. In connection with the instrument are two numbered dials to which a definite meaning is assigned in regard to electrical trouble. To each model of the various makes of electric system is assigned a key number which with the numbered dials can be used to locate trouble systematically.

The construction of the instrument is shown in the illustration. For testing purposes it is connected in series with one of the battery terminals. Then knowing the make of the electrical system, the key number for that system can be obtained from the charts which are supplied with instrument. The dials A and B are set so that the key number corresponding to the system is visible at the key number holes at the top of the instrument. The first test is with the engine idle, lamps off. If the system is normal the letter N will appear at the lower opening marked "engine idle, lamps off." If there is a discharge of current the pointer will indicate it and the lever C should be moved to bring the zero of the scale under the pointer. At the opening "engine idle, lamps off" the numbers 1 or 2 will appear. The number 1 indicates that there is a leakage of current somewhere in the system and the number 2 signifies that the cables connecting the instrument to the battery terminal are reversed. By referring to the chart the procedure for locating the trouble is outlined.

The second test is with the engine idle, lamps on. If the letter N appears at the opening it indicates that the system is normal. The number 4 indicates too much discharge and the number 5, not enough discharge. In either of these cases the charts corresponding to these numbers give definite instructions as to the method of procedure. The number 3 indicates a discharge and 6 means that the cables are reversed.

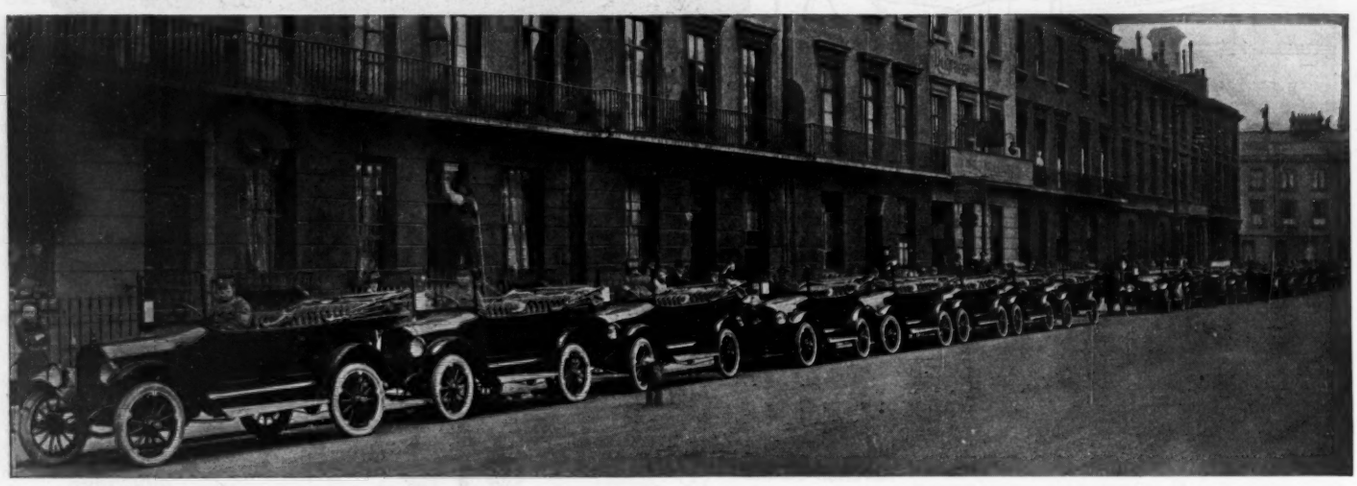
The third test is with the engine running, lamps off. If the charging rate is correct, when the lever C is moved to be under the zero of the scale, the letter N will appear at the left hand opening. The number 10 indicates too much charge and 9, not enough charge. The number 7 means no charge and 8 indicates that the current is reversed. In any of these cases the method to be pursued is outlined in the chart.

Step by Step

The charts refer to the proper page of the instruction books, where the procedure is explained step by step for correcting the trouble. The instrument also is provided with a low- and high-voltage scale, the former to be used for making battery cell readings and the latter for heavier work.

The instrument is manufactured by the American Bureau of Engineering, Inc., Chicago, and is supplied with the necessary cables, wiring diagrams and complete instructions for twenty-nine different makes of electrical systems. The price is $122.50.

Among the Makers and Dealers



WITH THE MAXWELL IN LONDON—A fleet of the Maxwells accepted by England for war duty in France. The Maxwell goes through two inspection tests before being delivered to the British government in London. All are tested thoroughly while being made. When shipped to the Maxwell branch in London the cars are given another inspection. Government inspectors subject the cars to a very stringent inspection. If they pass this test the cars are sent to a testing depot maintained by the British Government, about 40 miles from London. The Maxwells here undergo the most rigid inspection, and when accepted they are sent to Southampton and shipped direct to France for service with the army

MACDONALD with Curtiss Eng. Corp.—K. B. MacDonald has been elected vice-president of the Curtiss Eng. Corp., Garden City, N. Y. He was formerly vice-president of the Curtiss Aeroplane & Motors Corp.

Bosch Magneto Promotes Bennett—S. R. Bennett has been promoted to the position of supervisor of the testing departments of the Bosch Magneto Co. He was formerly assistant supervisor.

MacConnell Now with Hyatt Roller—C. E. MacConnell has joined the sales engineering staff of the Hyatt Roller Bearing Co. Mr. MacConnell was formerly advertising manager of the Detroit branch of the Goodrich Rubber Co.

U. S. Aircraft Buys Christopherson Plant—The United States Aircraft Corp., San Francisco, Cal., has bought the plant of the Christopherson Aircraft Co. Extensive improvements will be made and the capacity doubled.

Sanford Truck Prepares Expansion—At the annual meeting of the directors of the Sanford Motor Truck Co., Syracuse, N. Y., it was decided to erect a plant addition which will increase the floor space 50 per cent. This has been made necessary by the increase in business. Unfilled orders exceed $270,000. The capital will be increased by $100,000.

Hammered Piston Ring Buys Plant—The Hammered Piston Ring Co., recently incorporated in Maryland with a capital of $1,400,000, has purchased the plant of the American Piston Ring Co. of New Jersey, Newark, N. J. The new company also has acquired trademarks and equipment of the New Jersey corporation and will continue the business in much the same manner.

U. S. Truck Adds to Plant—Additions are being made to the plant of the United States Motor Truck Co., Cincinnati, Ohio. The present buildings occupy a space of one and a half blocks square, on which there are three sets of buildings three stories in height. To this group is being added a brick and steel building half a block square and three stories in height. This building is to be used for the testing department, paint shop and final assembly. Later there will be a new addition one and a half blocks long and three stories in height.

Harroun to Have Detroit Branch—The Harroun Motors Corp., Wayne, Mich., will open a factory branch in Detroit on motor row, with R. H. Schmittdiel as manager.

Miller with Wright-Martin Aircraft—K. C. Miller, after six years' service in the ordnance department of the Root & Vandervort Co., Rock Island, Ill., has resigned to become chief engineer of the Wright-Martin Aircraft Co., New Brunswick, N. Y.

Hinkley Motors on U. S. Work—The Hinkley Motors Corp. was one of the first Detroit companies to receive a Government contract for engines for army trucks, which is being filled. The capacity of the plant is from forty to fifty army truck engines a day, and production is gaining rapidly.

Perlman Rim Rushes New Building—Machinery is being installed in the new building erected by the Perlman Rim Corp., Jackson, Mich., to replace the one destroyed by fire last month and the building is being rushed to completion. It is expected that everything will be in readiness for manufacture very soon.

F-W-D Holds Sales Conference—A conference of district sales managers was held at the offices of the Four-Wheel-Drive Auto Co., Clintonville, Wis., recently, at which all matters pertaining to future campaigns were discussed. Among those present were T. J. McNamara, Cleveland, who has charge of the Ohio and western Pennsylvania territory; C. C. Dunkle, Chicago, who has charge of the Chicago territory; W. J. Prendergast, St. Paul, who has charge of the municipal sales, and J. S. Hurd, Milwaukee, who is the Wisconsin representative.

Reliance Truck Begins Plant Construction—The Reliance Motor Truck Co., Appleton, Wis., formerly the Racine Motor Truck Co., Racine, Wis., has broken ground for the first unit of its new motor truck manufacturing plant, to be 75 by 300 ft. The building alone will cost about $30,000 and the equipment an additional $25,000. Contracts call for the completion of construction work May 15. The Reliance company has a capital stock of $500,000 and represents the development of the motor truck business conducted for many years at Racine by Piggins Brothers. Ira L. Miller is president and T. M. Purtell is secretary.

Michigan Copper Earns $596,819—Net earnings of the Michigan Copper & Brass Co. for the year ending Dec. 31 were $596,819.41, after deducting $35,000 for income taxes, $136,000 excess profits taxes and $126,000 for depreciation, as compared with net earnings of $972,494 for 1916. This is equal to $60.20 a share on the $991,350 outstanding common stock.

To Make Kincannon Improved Gearset—The Kincannon Silent Transmission Co., organized recently at Boscobel, Wis., by George C. Kincannon, designer and patentee of an improved gearset for motor-driven vehicles, has perfected its organization by the election of the following officers: President, George C. Kincannon; vice-president, Peter Boebel; secretary, Roy Greenfield; treasurer, Richard Black. For the present the company will contract with outside machine shops for castings, gears, bearings and parts.

McGraw Tire Makers' Changes—The McGraw Tire & Rubber Co., East Palestine, Ohio, has made several changes in its organization. E. E. Hayslett has been appointed assistant treasurer, with H. B. Callahan as assistant. Robert Chaplow will be production superintendent and A. C. Redman, former traffic manager, will be industrial manager. W. E. Palmer has been promoted to the position of manager of the service department to succeed J. E. O'Hara, who resigned, and R. G. Nelson will be Pacific coast district manager.

Milwaukee Dealers Hold Annual Election—Alton J. March, manager of the Curtis Auto Co., Milwaukee, Wis., was re-elected president of the Milwaukee Automobile Dealers, Inc., at the annual meeting. R. C. Chidester, manager of the Milwaukee Packard branch, was elected vice-president; Jesse A. Smith, distributor of Hudson and Doble, treasurer; Alfred Reeke, distributor of Nash, secretary. The association has a membership of forty-five, embracing practically every dealer and distributor in Milwaukee. Bart J. Ruddle,

MAKING THE ROAD PERMANENT—It is with road machinery such as this that a path to market is opened to farmer and army truck alike. The United States needs as many of these roads as it can get

secretary of the National Automobile Dealers' Association, has been assistant secretary and manager of the association practically since its organization.

Caldwell Joins Ajax Rubber—Elmer E. Caldwell has been appointed assistant advertising manager of the Ajax Rubber Co., New York. Mr. Caldwell formerly was assistant advertising manager of the Michelin Tire Co.

Miller Gets Troy Wagon Promotion—A. R. Miller, formerly sales representative of the Troy Wagon Works Co., Detroit, has been appointed district sales manager for the company and will be located at Philadelphia, Pa.

Miller Gets Troy Wagon Promotion—A. R. Miller, formerly vice-president of the Wolverine Automobile Club and sales representative of the Troy Wagon Works Co., Detroit, has been appointed district sales manager for the company and will be located at Philadelphia, Pa.

Record Makes Price Sales Manager—The record of selling 50,000 pairs of Osgood lenses in Missouri during January, made by C. W. Price, president of the Auto Devices Co., of St. Louis, has caused Mr. Price to be selected as sales manager for the Osgood Lens & Supply Co., Chicago. He succeeds A. C. Fach, who resigned.

Schwerdtseger with Air-O-Flex—F. W. Schwerdtseger has been appointed designing engineer of the Air-O-Flex Automobile Corp., Detroit. Mr. Schwerdtseger formerly was chief engineer of the United States Motor Truck Co. and afterward became experimental engineer for the Federal Motor Truck Co., then designing engineer for the Denby Motor Truck Co.

Holihan Joins Standard Truck—J. A. Holihan has been appointed general sales manager of the Standard Motor Truck Co., Detroit. Mr. Holihan was formerly assistant general manager of the Briscoe Mfg. Co. and later became president and general manager of the Holihan Mfg. Co. For the last two years he has been district sales manager for the Federal Motor Truck Co.

Wisconsin Dealers Prepare for Spring—To fortify themselves against shortage of stocks when the spring rush begins, many Ford dealers in Wisconsin are coming to the Milwaukee branch plant of the Ford Motor Co. to requisition stocks and in cases where traffic congestion and heavy snows prevent delivery to the home salesroom the cars are being put into store in Milwaukee to await the time when they can be driven or shipped to points for distribution to buyers. The Service Motor Co., Fond du Lac, Wis., has leased large warehouse space in Milwaukee until spring to hold its stocks. The company's garage and warehouses at Fond du Lac are filled with more than 100 Ford cars purchased for spring delivery. Most of these cars were driven from the Milwaukee branch to Fond du Lac prior to Jan. 7, when the first of a series of five blizzards struck Wisconsin. Ford dealers at Green Bay, Oshkosh, West Bend, Sheboygan, Manitowoc, Appleton and other eastern Wisconsin cities are adopting the same plan as the Fond du Lac dealer. The plan has worked great relief to the congestion at the Milwaukee Ford plant, which threatened to become serious because of the inability to obtain freight cars and the impossibility of conducting extensive driveways, due to the unprecedentedly poor condition of highways as the result of the heaviest snowfall known in Wisconsin since 1881.

Coming Motor Events

SHOWS

Feb.	16-24—San Francisco, Cal.
Feb.	18-23—Syracuse, N. Y.
Feb.	18-23—Grand Rapids, Mich.
Feb.	18-23—Springfield, Ohio.
Feb.	18-23—Des Moines, Iowa.
Feb.	18-23—Duluth, Minn.
Feb.	18-23—Nashville, Tenn.
Feb.	18-25—Pittsfield, Mass.
Feb.	18-27—South Bethlehem, Pa.
Feb.	20-24—Quincy, Ill.
Feb.	23-March 2—Duluth, Minn.
Feb.	25-March 2—Salt Lake City, Utah.
Feb.	25-March 2—Muskegon, Mich.
Feb.	25-March 2—Indianapolis, Ind.
Feb.	26-March 2—Omaha, Neb.
Feb.	27-March 2—Columbus, Ohio.
Feb.	27-28—Burlington, Iowa.
March	2-9—Boston, Mass.
March	6-9—Clinton, Iowa.
March	6-9—St. Joseph, Mo.
March	6-9—Sioux Falls, S. D.
March	6-9—Mason City, Iowa.
March	6-9—Little Rock, Ark.
March	16-20—Great Falls, Mont.
March	20-23—Trenton, N. J.
March	20-23—Holdredge, Neb.
March	25-30—Rochester, N. Y.
April	1-6—York, Pa.
April	5-8—Green Bay, Wis.
April	9-13—Stockton, Cal.

Delling with Stanley Steamer Nod—E. H. Delling has been appointed designing engineer of the Stanley Motor Carriage Co. of Newton, Mass. He was formerly research engineer of the Saxon Motor Car Corp.

Loomis Gets Jackson Munitions Office—Gilbert Loomis has been elected secretary of the Jackson Munitions Corp., Jackson, Mich. Mr. Loomis formerly had been with the Packard company at Detroit, Louisville and St. Louis.

Moline Tractor Holds School—More than 100 farmers from all parts of the state of Ohio registered with the Ohio Moline Co., Columbus, Ohio, last week to attend the tractor school conducted by that concern. The school was instituted to give farmers practical instruction in using the Moline tractor.

Miller Rubber 1917 Earnings $831,271—Net earnings of $831,271 during the last year were reported at the annual stockholders' meeting of the Miller Rubber Co. recently. Jacob S. Pfeiffer was re-elected president; C. T. Grant, vice-president; William F. Pfeiffer, secretary and general manager; Frank B. Theiss, treasurer.

Case Holds Canadian Tractor School—Though the thermometer registered 40 deg. below zero, 217 Canadian farmers attended the recent tractor service school conducted by the J. I. Case T. M. Co. at its Saskatoon branch. All the farmers were actual or prospective farmers and anxious to learn more about caring for tractors.

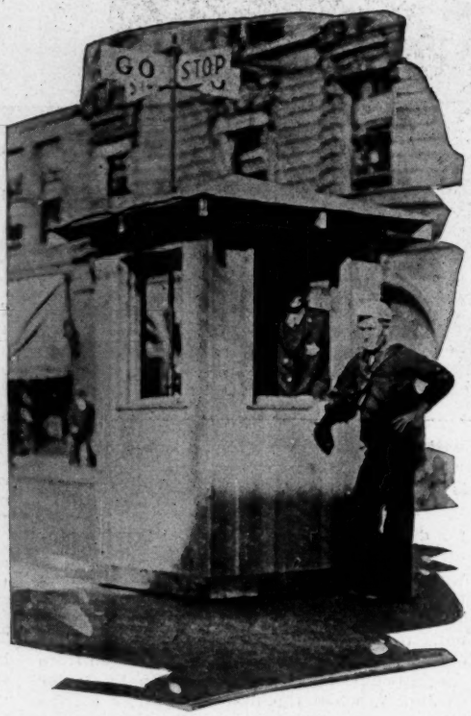
Republic Buys Los Angeles Factory—The Republic Motor Truck Co., Alma, Mich., has purchased a steel structure in Los Angeles, Cal., including 12½ acres of ground. This is to be used as a branch factory supplying a large part of the dealers in the South and West and also considerable foreign business which the company has in Japan, China, the Hawaiian Islands, the Philippines, Mexico and South America.

Slow Delivery Delays Boone Tire—Although its new factory buildings have been completed, delays in obtaining delivery of machinery and equipment is preventing the Boone Tire & Rubber Co., Sycamore, Ill., from placing its new plant at Chippewa Falls, Wis., in full operation. George N. Graham has been made general works manager and will take charge of both the Chippewa Falls and Sycamore factories.

Velie Makes Organization Changes—Charles R. Gardner, formerly manager of the Velie branch at Omaha, Neb., has been appointed assistant sales manager of the Velie Motors Corp., Moline, Ill. L. H. Hazard has been appointed superintendent of production; G. E. Martin, chief engineer; F. D. Soper, purchasing agent; and C. E. Mason, traffic manager. All these men have been with Velie a long time and are promoted to fill vacancies caused by entrance of former members of the Velie personnel into war service.

Republic Truck Organizes Social Club—A permanent social club for the department heads of the Republic Motor Truck Co., Alma, Mich., has been organized, which will be strictly a plant club following out the idea of the National Rotary Club with a representative from each department. L. R. Brown, general superintendent, was elected president of the club; H. A. Bliss, industrial head, vice-president; W. G. Rath, general office manager, secretary and treasurer. The object of the club will be to create, socially, an interest in the various departments.

From the Four Winds



PROTECTING THE POOR TRAFFIC COP—One of Detroit's traffic cops up in the air, left, at the junction of Woodward and Michigan avenues, called Campus Martius, doubtless because you have to fight to get across it. From this tower the traffic man controls and directs the traffic immediately surrounding him and also has supervision over several other traffic men stationed within a few hundred feet. The signals are thrown in the usual manner by a semaphore on the top of the tower

The physical comfort of the traffic policemen at Decatur, Ill., is provided for by a small house placed midway between the four corners of the street intersection. Glass windows have been placed on the four sides and heat is supplied by oil stoves. The semaphores are operated through the roof. The houses are light and can be easily stored during the summer

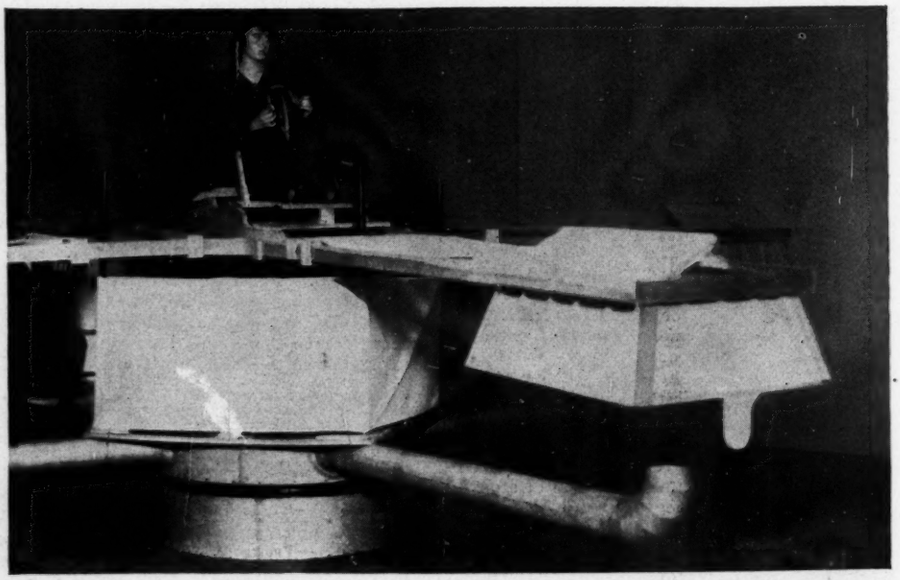
MOVES Cattle to Yards by Truck—James R. Elliott, Pendleton, Ind., has equipped a Maxwell truck with a cattle body and transports live stock from his farm to the Indianapolis stockyards. The distance between the two is 40 miles, and daily trips are made. During the last seven months repairs on the truck did not amount to $5.

Co-operation to Let Trucks By—All along the Lincoln highway this winter the residents have shown co-operation in keeping the roads clear for motor transportation. At Greensburg, Pa., sixty young men from the high school volunteered to do their bit of snow shoveling. The first trucks to get by as a result of their efforts were a train of Army trucks en route to Baltimore and the Goodyear Akron-Boston trucks.

Cannon Ball Trail Association Meets—The Cannon Ball Trail Association held a special meeting at Galesburg, Ill., recently to hear reports and outline the new year. Thirty sections were represented. President Thomas M. Beatty announced that the attitude of Governor Lowden, opposing expenditures for hard roads until after the war made it necessary to depend upon dragging to keep the highways in condition, and committees were named for each section to see that this dragging is given attention. Greater care of dirt roads is planned, and to effect this the committee in each county will take up with the county highway commissioners the necessity for such attention. The trail was in better condition last year than ever before. Some changes in the course between Aurora and Chicago were decided upon, 14 miles of dirt roads being substituted by new state-aid concrete roads. The route extends from Chicago to Kansas City via Aurora, Galesburg and Quincy. It was decided to select a day to be known as the "Cannon Ball Trail Day." Lectures will be given at each city on the route in behalf of good roads.

Introducing the Garageless Car—The garageless car was introduced during the recent cold weather to Chicago by a Franklin owner, E. F. McDonald, Jr., whose garage is situated in Grant Park and may be located by a certain lamp post which after a heavy snowstorm reveals just where the car lies beneath the surface. For nine days the car was submerged in a drift as high as the car, and then with the aid of two others Mr. McDonald dug it out none the worse for its hibernation.

Michigan County Towns Form New Road Body—As a result of a meeting of the members of the Otsego County road commission, members of the county board of supervisors and other leading citizens, held at Gaylord, Mich., to talk over the establishing of a through north and south trunk line, the Northern Michigan Tourists' Route Association was formed, and officers selected as follows: Chairman, H. B. Aldrich, Long Point; vice-president, John Yuill, Vanderbilt; secretary, County Clerk Sayre, Grayling; treasurer, John E. Wiggins, Wolverine. The proposition is to make a tourist pike which will run south from Cheboygan City along the west side of Mullet Lake and then to Wolverine and Vanderbilt, entering Gaylord by the Center Line road and passing south by way of Salling, Wah-Wah-Soo, Otsego Lake and Waters and then east, going through the Hardgrove section and into Frederic over the stone road which leads into that village from the east, then directly south along the main highway to Grayling. From Grayling the route proposed is by way of Portage Lake to Roscommon and thence over what is called the Gladwin route to Gladwin, Midland and Saginaw. Aside from the north and south trunk line through this county a trunk line to Johannesburg and gradually to the eastern line of the county also is proposed.



LEARNING TO FLY BY PROXY—This is one of the devices by which air students learn to balance a plane on the ground. It is so arranged that the operator gets the same sensations as to balance